TASK FINAL REPORT

on

PLANNING FOR A DATA BASE SYSTEM TO SUPPORT SATELLITE CONCEPTUAL DESIGN

(Report No. BCL-OA-TFR-76-11)

by

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FOREWORD

The study reported herein was carried out by Battelle's Columbus Laboratories for the NASA Office of Applications, as a task under Contract Number NASw-2800. The study task leader was Dr. Charles R. Claydon, and the work was done under the general supervision of Dr. A. C. Robinson, Battelle's manager for the contract. Task monitor in the Office of Applications was Mr. Walt McCandless, Code ESE. In addition, a number of discussions were held with Mr. Bob Nagler of JPL during the course of the study, and his assistance is gratefully acknowledged.

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PLANNING FOR A DATA BASE SYSTEM TO SUPPORT SATELLITE CONCEPTUAL DESIGN

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I. INTRODUCTION

A. Background

This report summarizes the plans for a data base system to support satellite conceptual design. The planning study was proposed March 22, 1976, in response to a February 26, 1976, directive to Battelle's Columbus Laboratories (BCL) from NASA's Mr. Forrest Waller. A copy of the task statement of work is attached to this report as Appendix A.

Based upon the statement of work and conversations with Mr. Robert Nagler of the Jet Propulsion Laboratory (JPL), Battelle personnel developed a conceptual design of an automated data base system. The data base consists of the satellite catalog prepared by JPL personnel. The preparation of a sensor catalog and a science and applications opportunities catalog is planned by JPL staff. Upon completion of these catalogs, they will become part of the data base. To support usage of the data base for satellite conceptual design, the conceptual system design utilized capabilities of the BASIS storage, retrieval, and analysis system. The satellite catalog and the BASIS system are described briefly below.

B. The Satellite Catalog

During fiscal year 1975 the preparation of a satellite catalog was initiated by JPL staff. Data were cataloged and synthesized for all Earth orbital satellites funded to the hardware stage for launch between 1970 and 1980. Assistance with data collection was provided by personnel of satellite prime contractors.

The objective of the satellite catalog effort is the concise compilation of satellite capabilities and design parameters. The categories of data collected are

- Project and contractor identification
- Trajectory parameters
- Satellite design parameters
- Payload design parameters
- Launch date, site, vehicle identification
- Stabilization method
- Attitude control design parameters
- Attitude reference sensor design parameters
- Power source
- In-orbit propulsion functions
- Telemetry parameters
- Command parameters
- Tracking parameters
- Clock parameters.

The detailed list of data elements is discussed in Section III.C. It should be noted that at present only a few key sensor payload parameters have been included in the satellite catalog. As a part of future JPL data collection, the satellite catalog will be updated with data on the cost of satellite subsystems and components.

In concert with the satellite catalog preparation, the cataloging of design parameters of sensors was initiated. When it is completed, this sensor catalog will include sensors flown on satellites that are contained in the satellite catalog or that are under funded development for future programs.

A future phase of the JPL data cataloging effort will be the preparation of a science and application opportunities catalog. This effort will emphasize opportunities that have recognized economic, social, or scientific return. These opportunities include the exploration for, utilization of, and protection of Earth resources.

C. The BASIS Storage, Retrieval, and Analysis System

Battelle personnel developed a conceptual design of a computerized data base system to support satellite conceptual design during early option studies. This data base system design utilizes the capabilities of BASIS, a Battelle designed and developed information storage, retrieval, and analysis system. BASIS has been used in several hundred data base applications for dozens of governmental and private business organizations.

The BASIS system allows users to search large files of textual or numeric information by key words and phrases and by numeric value and range. The user does not need a knowledge of computers to successfully search the data base, retrieve selected information, and apply analysis procedures. Advantages of the utilization of BASIS to support the satellite catalog are the ability of the user to

- Create and maintain large and small data bases
- Combine textual and numeric information in the same data base
- Index the information by key words, key word phrases, numeric value, and numeric range
- Use a thesaurus to control vocabulary in the index
- Compute arithmetic expressions
- Analyze data statistically
- Plot data in a variety of user-specified formats
- Tabulate data in a variety of user-specified formats
- Specify tailored report formats

- Sort records by one or more data elements
- Provide customized user-computer dialog
- Monitor complete user-computer interaction for later analysis.

A more complete discussion of BASIS capabilities is provided in Section III.D.

II. OBJECTIVES

The objectives of this data base system planning task are:

- The conceptual design of an automated system to support the use of
  - the satellite catalog
  - the sensor catalog when it is completed
  - the science and application opportunities catalog when it is completed
- The recommendation of a plan for implementation of of the data base system
- The estimation of costs for development and operation of the system.

The automated data base system is to be used in conjunction with studies to evaluate the cost effectiveness of future NASA missions. To support this goal, the data base must be organized so that candidate satellite systems can be selected based upon

- Demonstrated existing capabilities
- Flexibilities inherent in each satellite design that would allow additional capabilities without major redesign and/or requalification.

III. CONCEPTUAL SYSTEM DESIGN

As a prelude to the discussion of the results of the conceptual design of an automated data base system, the methodology used by Battelle personnel for system design will be addressed. Over the last 7 years, Battelle staff have acquired extensive experience in the analysis, evaluation, conceptualization, design, development, implementation, and operation of data base systems. The entire system development process is approached in a logical progression. This permits examination of necessary decisions and available alternatives and permits making each decision in full awareness of its interaction with, or effect upon, other elements of the system. Experience has indicated that a step-by-step approach is most likely to produce a coordinated, effective system that is responsive to user needs.

In designing a computerized data base system, Battelle personnel follow the general steps illustrated in the following discussion. Specific work elements are modified wherever necessary to meet the requirements of the project and to incorporate lessons learned. Some elements may be eliminated on the basis of knowledge already available to the sponsor or because certain sponsor requirements are already clearly identified. However, each element is commented upon to indicate Battelle's approach to that particular portion of the system design. The general system design steps are:

- Analysis of System Requirements

  - Definition of the User Group. The value of an automated data base system must be measured in terms of its ability to satisfy the needs of those who use it. Thus, first attention must be to the user group. Who are they and what information do they need? The answer to the first question is the definition of the user group. The primary user group is usually the sponsor staff which use the system to respond to inquiries, and most attention is devoted to its needs. However, the influences of the audiences and recipients of service should not be neglected. A review of the project sponsor organizational structure, objectives, and functions is also vital to definition of the system user group.

- Determination of User Needs. Once the identity of the user group is established, Battelle staff conduct a survey to determine the information needs of the user group. The most direct approach is to ask some or all of the users, by personal interview or questionnaire, what types of information they have needed in the past and anticipate needing in the future.

- Establishment of System Requirements. Battelle staff evaluate and analyze the results of the user-needs study to establish system requirements. These requirements are discussed with sponsor personnel to be certain that they are in keeping with present and anticipated policies and objectives of the sponsor. Particular note is taken of policies and objectives that may be subject to considerable change.

- Development of a System Design

  - Definition of Required Coverage (Data Elements). The information needs of the user group provides the basis for determining the coverage of the system. Coverage is defined by a number of parameters, including (1) which specific scientific and technical subject areas will be included, (2) whether information (ideas) or data (unit facts) or both will be included, and (3) the level of work to be included (on-going and/or completed work). The aim is to select limits within which the system can provide broad coverage with maximum benefit to the greatest number of users.

  - Identification and Examination of Appropriate Sources. Once the limits of coverage are defined, Battelle staff generate a list of specific sources from which the information could be acquired most efficiently. In most cases this would involve examination and evaluation of sources such as journals, books, patents, technical reports, correspondence, and design drawings.

  - Definition of Types and Forms of Input Documents. This step in system design is aimed at summarizing the two previous steps to gain a clear picture of the variety of form and content of input documents required by the system.

  - Establishment of Level and Types of Services Required. The services to be provided are established after user needs have been analyzed, and information coverage and sources are determined. Two distinct decisions are involved: selection of the types of services and the levels of service to be offered.

The user-needs study indicates the types of services required. That is, users would need either a current-awareness service or a retrospective-searching service or both. A current-awareness service keeps users abreast of current information. A retrospective-searching service stores information and allows retrieval of it in response to specific requests. The user-needs study also indicates the level of service users need. The levels of service provided by systems vary from simple document referral services to complex analysis. It is necessary to select a range of services that provides users with the information in the most usable form. If the level of service is subject to change, the widest anticipated range should be selected.

- Definition of System Functions. Once the level and types of services are specified, the necessary types and forms of system output are clear. Thus, it is possible to specify the functions involved in converting the input information into the output information and services. Some examples of typical functions performed by data base systems are acquisition, screening, abstracting, indexing, storage and retrieval, and analysis and synthesis of information and data.

- Specification of System Operations. This work element goes beyond the naming of functions to be performed to describe how the named functions should be performed. A major decision at this point is the selection of an appropriate indexing or classification system by which important ideas in the input documents are identified and reduced to index data. Document acquisition and input screening are other operations whose procedures must be specified at this stage of system design. In all cases, alternative methods available are weighted in terms of their compatibility with other elements of the system and their ability to meet the needs of the users.

- Selection of Storage Media. In general, the selection of storage media follows, and is dependent upon, the specification of system operations. In most operations, two things are stored: documents and index data. They may be stored together or separately, depending upon system requirements as well as the types of documents and index data involved. The typical media considered are: hardcopy, microfilm, and computer readable magnetic storage (tape and or disk).

- Provision for Monitoring and Accounting. Before a data base system can be considered complete, provision must be made for monitoring the system to maintain economic control and quality control. Monitoring also is essential to provide for evolutionary improvement of the system. The level of mechanization of the monitoring and accounting system should be determined by the level of mechanization of the storage systems. For a fully automated system, statistics such as indexing cost per document and number of searches per month can be registered and accumulated so that the sponsor is in a position to evaluate costs of installation and operation and the efficiency of the resulting services.

For the specific system design which is the subject of this planning task, many of the above-mentioned design steps were not performed because early design perogatives were exercised by JPL personnel. In these cases, a review of such decisions was made by Battelle staff to assess the remaining design alternatives. Design steps for which prior decisions were made are

- Definition of the User Group - in setting of the objectives of the system, the JPL staff have indicated that the user group consists of satellite conceptual designers and mission planners.

- Definition of Required Coverage (Data Elements) - the contents of the data catalogs were determined by JPL staff before Battelle personnel started the planning task.

- Identification and Examination of Appropriate Sources - the source of data, the satellite prime contractors, was determined by JPL staff when the satellite cataloging effort was initiated.

- Determination of Types and Forms of Input Documents - the initial data collection form was designed by JPL staff; a revised form was submitted by a satellite prime contractor.

- Establishment of Level and Types of Services Required - in setting of the objectives of the system, the JPL staff determined that retrospective searching is the type of service required and that the level of service required ranges from catalog referral to complex mathematical analysis.

- Selection of Storage Media - by limiting the conceptual design alternatives to an automated data base that can be utilized in interactive mode, the scope of this planning task has essentially predetermined magnetic disk storage as the only viable medium for storage of the catalog and index data.

A summarization of the results of the design steps is provided in Figure 1. For the above-mentioned predetermined steps, little additional discussion is provided in this report. The rest of this section summarizes the results of the performance of the remaining design steps:

- Determination of user needs
- Establishment of system requirements
- Design of data base structure
- Assessment of the BASIS system capabilities for support requirements
- Discussion of system requirements not supported by BASIS
- Design of special output displays (tables and graphs).

FIGURE 1. SUMMARY OF THE CONCEPTUAL SYSTEM DESIGN RESULTS

System Design Step	Report Reference	Summary of Results
Analysis of System Requirements		
Definition of the User Group	Section III.A.	The data base system users are the personnel of NASA Headquarters and Research Centers who are: • Performing satellite conceptual design • Evaluating the cost effectiveness of future NASA missions.
Determination of User Needs	Section III.A.	The study has determined that: • Data base information display is needed in a variety of formats • Data base searching is needed for - Satellite capability search mode - Satellite design search mode - Satellite subsystem supplier search mode • User oriented dialog for interaction with the data base system is needed.
Establishment of System Requirements	Section III.B.	The data base system requirements are the capabilities for • Data base creation and maintenance • Selective (tabular and graphical) display of satellite catalog information • Search by gross (Level 1) capability categories (capability search) • Search by gross (Level 1) design parameters (design search) • Search by detailed (Level 2) capability categories • Search for subsystem suppliers by detailed (Level 2 and 3) capabilities • Tabular display of requested capability or design parameter information • Graphical display (on both teletype compatible and graphic terminals) of design parameter data • Utilization of cost estimating relationships in simple computational statements and in complex mathematical or statistical methodologies.

FIGURE 1. SUMMARY OF THE CONCEPTUAL SYSTEM DESIGN RESULTS (CONTINUED)

System Design Step	Report Reference	Summary of Results
Development of a System Design		
Definition of Required Coverage (Data Elements)	Appendix F	A satellite catalog, prepared by JPL staff, covered all Earth orbital satellites funded to the hardware stage for launch between 1970 and 1980. Assistance with data collection was provided by personnel of satellite prime contractors. The categories of data collected are: • Project and contractor identification • Trajectory parameters • Satellite design parameters • Payload design parameters • Launch date, site, vehicle identification • Stabilization method • Attitude control design parameters • Attitude reference sensor design parameters • Power Source • In-orbit propulsion functions • Telemetry parameters • Command parameters • Tracking parameters • Clock parameters.
Identification and Examination of Appropriate Sources	Section I.B.	The satellite catalog is being compiled by JPL staff with the assistance of satellite prime contractor personnel. The data source is thus satellite prime contractor design documents.
Definition of Types and Forms of Input Documents	Appendix C Appendix D	Two formats of data collection forms were identified: • The JPL designed form • The revised form submitted by a satellite prime contractor.

FIGURE 1. SUMMARY OF THE CONCEPTUAL SYSTEM DESIGN RESULTS (CONTINUED)

System Design Step	Report Reference	Summary of Results
Establishment of Level and Type of Services	Section III.B.	The type of service required is a retrospective-searching capability. The level of service required ranges from simple catalog referral to complex mathematical analysis.
Definition of System Functions	Section III.B.	The system functions are to provide information storage, retrieval, analysis, and output display in specially designed formats such as data tables and plots.
Specification of System Operation	Section III.B., C., D.	Information storage and retrieval functions are to be performed by the BASIS system utilizing the inverted file indexing technique. Specialized output displays are to be provided by the tabular formatting and plotting capabilities of the BASIS system.
Selection of Storage Media	Section III	Magnetic disk storage is required for delivery of services in an interactive mode.
Provision for Monitoring and Accounting	Section III.D.3	Monitoring and accounting of system usage is required to maintain economic control and quality control of the system and to provide guidance for evolutionary improvement of the system.

A. Determination of User Needs

The determination of data base system user needs was not made in the customary manner of interviewing the user group. The user group was defined via task objectives in only a general sense. The data base system users are the personnel of NASA Headquarters and Research Centers who are

- Performing satellite conceptual design
- Evaluating the cost effectiveness of future NASA missions.

With such a general user group definition, no attempt to interview prospective users was made. Rather, an initial determination of user needs was based upon conversations with Mr. Robert Nagler of JPL. As a result of these conversations, Mr. Nagler outlined his perception of searching, display, and analysis functions needed by the data base system user. This detailed list of functions is attached to this report as Appendix B. After additional analysis of the objectives of the data base system and of the services it should deliver, the user needs were categorized as:

- Data base creation and updating capabilities are needed to maintain the currency and accuracy of the data catalogs.
- Interactive time-shared access to the data base is needed to perform the functions of satellite conceptual design and cost effectiveness analysis.
- Catalog information needs to be selectively displayed; options to be selected by the user are the level of detail and the categories of data desired.
- Data base searching modes are needed for
  - Satellite capability
  - Satellite design parameters
  - Satellite subsystem supplier.
- Catalog information needs to be appropriately indexed to support the searching modes; indexing is needed by
  - Key words
  - Key word phrases
  - Data values
  - Data value ranges.

- Tabulation of data is needed in a variety of user-specified formats.
- Plotting of data is needed in a variety of user-specified formats.
- Analytical capabilities are needed to specify arithmetic expressions and to statistically analyze data.
- Customized, user-oriented dialog is needed for the user-system interface.
- Monitoring of system usage is needed to provide evolutionary improvement of the system.

The data base system requirements to support these categories of user needs will be discussed in the next part of this section.

B. Establishment of System Requirements

In order to establish requirements for a data base system, the following system design criteria were utilized:

- The system development and operating cost should be minimized.
- The system implementation time should be minimized.
- The system should be implementable on a wide variety of computer vendor hardware systems.
- Full support of user needs should not be sacrificed to achieved the other design criteria.

One of the initial design decisions was to utilize a commercially available data base storage and retrieval system. The advantages of utilization of an existing system over the design and development of a new system are

- The investment of time and money is minimized.
- A state-of-the-art system is obtained.
- Continuing support and enhancement of the system is available from the vendor.
- From the large number of commercially available systems, one can usually be chosen that satisfies the system design criteria.

A brief survey of commercially available storage and retrieval systems indicated several candidates. Of these candidate systems, the BASIS system offers the widest range of needed capabilities in addition to information storage and retrieval. Some of these capabilities are:

- Versatile data tabulation
- User-formatted data plotting
- Arithmetic expression evaluation
- Statistical analysis procedures
- Record sorting by data elements

- Customized user-computer dialog
- Tutorial procedures
- Complete user-computer interaction monitoring for later analysis.

A more complete description of the BASIS system capabilities is provided in Section III.D.

The data base system requirements to be established were categorized according to

- Hardware requirements
- Software requirements
- Personnel requirements.

Since this planning task is to provide a conceptual system design, the system requirements have not been determined to the detail of hardware model numbers or personnel job descirptions.

To support an interactive, time-shared data base system, the following basic hardware elements are required:

- A time-sharing computer central processor
- Input-output devices such as
  - Card readers/punches
  - Magnetic tape readers
  - Terminals (teleprinters or graphic displays)
  - Auxilliary devices (optical character recognition, OCR, and computer output microfilm, COM, equipment)
- Storage media such as
  - Disk packs
  - Mass storage.

The data base of satellite information will be accessed by users at many geographical locations such as NASA Headquarters and Research Centers. Thus, the following additional hardware is required:

- Telecommunications service (either analog or digital)
- Modems or multiplexors.

The specific determination of hardware requirements should be made at the time that the conceptual design is implemented. Factors which will influence hardware specifications are

- The number of simultaneous users to be serviced
- The response time desired by users
- The amount of information to be stored
- The geographic distribution of the users.

A discussion of the optimal choice of hardware for any specific set of factors is beyond the scope of this report.

The prime software requirement is the BASIS system. To support implementation of the BASIS system, a FORTRAN compiler and a time-sharing operating system are required. BASIS can be implemented using a wide variety of compilers and operating systems supplied by the computer vendor. For example, BASIS is currently operational on Control Data, Univac, Digital Equipment Corporation, Xerox, and International Business Machine products.

Personnel requirements are minimal for the data base system since it will utilize BASIS. Software maintenance is provided by Battelle. Only the data management team need be at the computer site. The data management team usually consists of the project supervisor, a computer systems analyst, and a keypunch operator. It is anticipated that for support of the catalog of satellite data, the updating activity will be slight. Thus, only part time involvement by the team is required to operate the data base system.

In addition to the above-mentioned hardware, software, and personnel requirements, the data base system must provide specific capabilities to support the needs of the system users. These capabilities include (a) data base creation and maintenance, (b) selective (tabular and graphical) display of satellite catalog information, (c) search by gross (Level 1) capability categories (capability search), (d) search by gross (Level 1) design parameters (design search), (e) search by detailed (Level 2) capability categories, (f) search for subsystem suppliers by detailed (Level 2 and 3) capabilities, (g) tabular display of requested capability or design parameter information, (h) graphical display (on both teletype compatible and graphic terminals) of design parameter data, and

(i) utilization of cost estimating relationships in simple computational statements and in complex mathematical or statistical methodologies. A detailed list of Level 1 and Level 2 capability and design parameter information to be used for search criteria for items (c) through (g) is provided in Appendix B.

C. Design of Data Base Structure

The initial data collection form, excerpts of which are illustrated in Figure 2, shows the data elements sought by JPL staff in their initial efforts to have satellite prime contractors provide satellite design parameter characteristics. In response to the request for data, one satellite prime contractor redesigned the data collection form to include more detailed data on telemetry, tracking, and command. Excerpts of the revised data collection form are illustrated in Figure 3. The entire data collection forms from which Figures 2 and 3 were excerpted are attached as Appendixes C and D.

After studying the initial and revised data collection forms (Appendices C and D), the individual data elements to be stored in the satellite catalog data base were defined and a new revision of the data collection was proposed. This proposed composite data collection form, excerpts of which are shown in Figure 4, is actually a merger of data elements from the earlier versions of the data collection form. However, it differs greatly in appearance because some composite data elements were separated into several individual data elements. For example, "Design Trajectory" was separated into "Trajectory Altitude", "Trajectory Inclination", "Trajectory Eccentricity", and "Trajectory Period". The entire proposed composite data collection form is attached as Appendix E.

The results of the detailed specification of the individual data elements are illustrated in Figure 5. The full list of data base field specifications are attached as Appendix F. This detailed specification constitutes the major portion of the data base file design. The remaining specifications of the file structure are the default settings for options available to the user of the data base during record retrieval and information display operations. These remaining specifications are not shown in this report.

The detailed data element specifications were designed so that they could be easily modified should testing of the prototype data base indicate a need for refinement of specifications. Thus, the fields, or data elements, were numbered with vacancies left for future use. The meaning of the number and letter codes in the columns in Figure 5 have the following meaning:

FIGURE 2. EXCERPTS FROM THE INITIAL JPL DESIGNED DATA COLLECTION FORM*

SATELLITE INFORMATION FILE

Data Element:	Sample Data:
Program Name	Civilian Meteorology/Defense Meteorology(DMSP)
Program Sponsor	NOAA-NASA/DoD
Project Name	TIROS, ITOS, SMS/Block 5D-1
Project Manager	NESS-GSFC/Air Force
Prime Contractor	RCA, RCA, Philco-Ford/RCA
Sensor Type	Passive V&IR/Passive μω/F&P/X-ray
Sensor Acronyms	
Launch Date(s)	
In-Flight Experience (Yrs.)	
Design Life (Goal, Expendables Sized) (Yrs.)	
Trajectory Class	Polar/Sun Sync/Geostationary/Geosync/Elliptical
Design Trajectory (Periapsis Altitude, Inclination, Eccentricity, Period) (km, Deg., Min.)	
Data elements omitted	
Payload Data Production Rate(s) (b/s)	
Telemetry Data Rate(s) (b/s)	
Telemetry Link Characteristics (Frequency, Bandwidth, RF Power, Coding, Modulation) (GHz, MHz, W)	VHF: .139, .01, 6, Convolution, RZ PCM PSK/S-Band: 2.300, .1, 20, Block, PCM FSK
Telemetry Transmitter Technology	TWT/Solid State
Telemetry Transmitter Manufacturer	
Data elements omitted	
Data Storage (Type, Number, Capacity, Record Rates, Playback Rates) (b, b/s)	Tape/Solid State/Bubble/Film, #, $10^6/10^8/10^9/10^{10}$, 25k/500k
Data Storage Manufacturer	
Data elements omitted	

*The complete data collection form is attached as Appendix C.

FIGURE 3. EXCERPTS FROM THE REVISED DATA COLLECTION FORM SUBMITTED BY A SATELLITE PRIME CONTRACTOR*

SATELLITE INFORMATION FILE

Data Element:	Sample Data:
Program Name	OSO
Program Sponsor	
Project Name	OSO - I
Project Manager	
Prime Contractor	Hughes Aircraft Co.
Sensor Experience	Multichan. UV/Vis Spec., Cosmic X-Ray Spec., Soft X-Ray, Crystal Spec. Polarimeter, High Energy Celestral X-Ray, Mapping X-Ray Heliometer
Sensor Acronyms	
Launch Date(s)	1975
In-Flight Experience (Yrs.)	
Design Life (Goal, Expendable Sized) (Yrs.)	1 Yr.
Trajectory Class	160 km. 30°, 0, 100 min
Design Trajectory (Periapsis Altitude, Inclination, Eccentricity, Period) (km, Deg., Min.)	
Data elements omitted	
Telemetry	
Ground system compatibility (NASA/GSFC, Aerospace Standards, SGLS, etc.)	NASA/GSFC
Channel capacity (No. of Channels)	
Channel type (analog, digital, bi-level)	
Data rate or baseband (Hz)	6.4 kbps RT, 128 kbps stored data
Data source encoding type (PCM, ΔMOD)	8 bit PCM, Manchester coded
Channel encoding type (convolutional, etc.)	
Subcarrier frequency, if used (Hz)	
Subcarrier modulation, technique (FSK, PSK, etc.)	

*The complete data collection form is attached as Appendix D.

FIGURE 3. EXCERPTS FROM THE REVISED DATA COLLECTION FORM SUBMITTED BY A SATELLITE PRIME CONTRACTOR (CONTINUED)

Data Element:	Sample Data:
Data/subcarrier modulation index (radians, etc.)	
Carrier frequency (MHz)	136.92 MHz-real time; 2212.5 MHz-stored data
Carrier stability (± Hz)	
Carrier modulation technique (PM, FM, etc.)	PM
Subcarrier/carrier modulation index (radians, etc.)	S-Band: 1 radian; VHF: 1.44 radian
Transmitter RF level, tol. (watts, ± watts)	1 W VHF, 1 W S-Band
Transmitted EIRP, tol. (dBm, ± dB)	
Occupied RF bandwidth (MHz)	
Telemetry subsystem concept (centralized, data bus, etc.)	
Storage capabilities (medium, data bits, programmable, etc.)	Not reprogrammable, tape recorder (1), 8.6×10^7 bits. PB @ 128 kbps
Telemetry subsystem manufacturers	Hughes/EMM/Opetics

Data elements omitted

FIGURE 4. EXCERPTS FROM THE PROPOSED COMPOSITE DATA COLLECTION FORM*

FIELD TITLE	FIELD
Ident	2
Accession Number	3
File Name	4
Subfile Name	5
Program	7
Program Name	8
Program Sponsor	9
Project	10
Project Name	11
Project Manager	12
Prime Contractor(s)	14
Prime Contractor	15
Prime Contractor	16
Prime Contractor	17
Trajectory	20
Trajectory Class	21
Trajectory Altitude	22
Trajectory Inclination	23
Trajectory Eccentricity	24
Trajectory Period	25
Fields omitted	
Data Rate, Payload Prod.	230
Data Rate, Payload	231
Telemetry	240
Telemetry Identification	241
Tele Ground Sys Compatibility	242
Tele Sys Concept	243
Tele Sys Mfgr	244
Tele Sys Storage	246
Tele Sys Storage Type	247
Tele Sys Storage Quantity	248
Tele Sys Storage Capacity	249
Tele Sys Storage Record Rate	250
Tele Sys Storage Playback Rate	251
Tele Sys Storage Programblty	252
Tele Sys Storage Mfgr	253
Tele Data Rate	255
Tele Digital Data Rate	256
Tele Analog Baseband	257

FIELD TITLE	FIELD
Tele Carrier	260
Tele Carrier Frequency	261
Tele Carrier Freq Range Min	262
Tele Carrier Freq Range Max	263
Tele Carrier Stability	264
Tele Carrier Bandwidth	265
Tele Carrier Modulation Tech	266
Tele Data Coding Tech	267
Tele Data Coding Tech (1)	268
Tele Data Coding Tech (2)	269
Tele Data Coding Tech (3)	270
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Tele Channel Type (2)	302
Tele Channel Type (3)	303
Tele Channel Type (4)	304
Tele Channel Capacity (1)	305
Tele Channel Capacity (2)	306
Tele Channel Capacity (3)	307
Tele Channel Capacity (4)	308
Tele Channel Coding Tech	309
Fields omitted	

*The complete data collection form is attached as Appendix E.

FIGURE 5. EXCERPTS FROM THE SATELLITE CATALOG DATA ELEMENT SPECIFICATIONS*

Level	Category Code	Class	Index	Search Level	Design Level	Field	Field Mnemonic	Field Title
0	00.	M				2	IDENT	Ident
1	00.1	I	I			3	ACC	Accession Number
1	00.2	S	I			4	FILE	File Name
1	00.3	S	I			5	SUBFILE	Subfile Name
0	01.	M				7	PROGRAM	Program
1	01.1	S	I	C1		8	PROG	Program Name
1	01.2	S	I	C1		9	SPONSOR	Program Sponsor
0	02.	M				10	PROJECT	Project
1	02.1	S	I	C1		11	PROJ	Project Name
1	02.2	S	I	C1		12	MANAGER	Project Manager
0	03.	M				14	PRIME	Prime Contractor(s)
3	03.1.1.1	S	I	C1		15	PRIME1	Prime Contractor
3	03.1.1.2	S	I	C1		16	PRIME2	Prime Contractor
3	03.1.1.3	S	I	C1		17	PRIME3	Prime Contractor
0	04.	M				20	TRAJECTORY	Trajectory
1	04.1	S	I	C1	D1	21	TRAJC	Trajectory Class
2	04.1.1	R	N			22	TRAJA	Trajectory Altitude
2	04.1.2	R	N			23	TRAJI	Trajectory Inclination
2	04.1.3	R	N			24	TRAJE	Trajectory Eccentricity
2	04.1.4	R	N			25	TRAJP	Trajectory Period
	Fields omitted							
0	13.	M				230	DATARATE	Data Rate, Payload Prod.
1	13.1	R	R	C1	D1	231	DRP	Data Rate, Payload
0	14.	M				240	TELEMETRY	Telemetry
1	14.1	M				241	TIDENT	Telemetry Identification
2	14.1.1	S	N			242	TGSC	Tele Ground Sys Compatibility
2	14.1.2	S	N			243	TSC	Tele Sys Concept
3	14.1.2.1	S	N			244	TSM	Tele Sys Mfgr
1	14.2	M				246	TSSTORAGE	Tele Sys Storage
2	14.2.1	S	N			247	TSST	Tele Sys Storage Type
2	14.2.2	I	N			248	TSSQ	Tele Sys Storage Quantity
2	14.2.3	R	N			249	TSSC	Tele Sys Storage Capacity
2	14.2.4	R	N			250	TSSRR	Tele Sys Storage Record Rate
2	14.2.5	R	N			251	TSSPR	Tele Sys Storage Playback Rate
2	14.2.6	S	N			252	TSSP	Tele Sys Storage Programblty
3	14.2.6.1	S	N			253	TSSM	Tele Sys Storage Mfgr
1	14.3	M				255	TDATARATE	Tele Data Rate
2	14.3.1	R	R	C1		256	TDDR	Tele Digital Data Rate
2	14.3.2	R	R	C1		257	TABB	Tele Analog Baseband
1	14.4	M				260	TCARRIER	Tele Carrier
2	14.4.1	R	R	C2		261	TCF	Tele Carrier Frequency
2	14.4.2	R	R	C2		262	TCFMIN	Tele Carrier Freq Range Min
2	14.4.3	R	R	C2		263	TCFMAX	Tele Carrier Freq Range Max
2	14.4.4	R	N			264	TCS	Tele Carrier Stability
2	14.4.5	R	N			265	TCB	Tele Carrier Bandwidth
2	14.4.6	S	N			266	TCMT	Tele Carrier Modulation Tech
1	14.5	M				267	TCODING	Tele Data Coding Tech
2	14.5.1	S	I	C2		268	TDCT1	Tele Data Coding Tech (1)
2	14.5.2	S	I	C2		269	TDCT2	Tele Data Coding Tech (2)
2	14.5.3	S	I	C2		270	TDCT3	Tele Data Coding Tech (3)
2	14.5.4	S	I	C2		271	TDCT4	Tele Data Coding Tech (4)
1	14.6	M				275	TPOWER	Tele Transmitter RF Power
2	14.6.1	R	R	C2		276	TTRFL	Tele Transmitter RF Level
2	14.6.2	R	R	C2		277	TTRFLT	Tele Transmitter RF Tolerance
2	14.6.3	R	R	C2		278	TTEIRP	Tele Transmitted EIRP
2	14.6.4	R	R	C2		279	TTEIRPT	Tele Transmitted EIRP Tol.
1	14.7	M				290	TSCARRIER	Tele Subcarrier
2	14.7.1	R	N			291	TSCF1	Tele Subcarrier Freq (1)
2	14.7.2	R	N			292	TSCF2	Tele Subcarrier Freq (2)
2	14.7.3	R	N			293	TSCF3	Tele Subcarrier Freq (3)
2	14.7.4	R	N			294	TSCF4	Tele Subcarrier Freq (4)
2	14.7.5	S	N			295	TSCM1	Tele Subcarrier Modul (1)
2	14.7.6	S	N			296	TSCM2	Tele Subcarrier Modul (2)
2	14.7.7	S	N			297	TSCM3	Tele Subcarrier Modul (3)
2	14.7.8	S	N			298	TSCM4	Tele Subcarrier Modul (4)
2	14.7.9	R	N			299	TSCMI	Tele Sub/Carrier Index

*The complete data element specifications form is attached as Appendix F.

FIGURE 5. EXCERPTS FROM THE SATELLITE CATALOG DATA ELEMENT SPECIFICATIONS (CONTINUED)

Level	Category Code	Class	Index	Search Level	Design Level	Field	Field Mnemonic	Field Title
1	14.8	M				300	TCHANNEL	Tele Channel
2	14.8.1	S	N			301	TCT1	Tele Channel Type (1)
2	14.8.2	S	N			302	TCT2	Tele Channel Type (2)
2	14.8.3	S	N			303	TCT3	Tele Channel Type (3)
2	14.8.4	S	N			304	TCT4	Tele Channel Type (4)
2	14.8.5	R	N			305	TCC1	Tele Channel Capacity (1)
2	14.8.6	R	N			306	TCC2	Tele Channel Capacity (2)
2	14.8.7	R	N			307	TCC3	Tele Channel Capacity (3)
2	14.8.8	R	N			308	TCC4	Tele Channel Capacity (4)
2	14.8.9	R	N			309	TCCT	Tele Channel Coding Tech

Fields omitted

- Level: The initial JPL designed data collection form was organized as a hierarchy of data elements; the level indicated in Figure 5 is the level of that data element hierarchy with level 0 serving as group identifier.

- Category Code: The category code is an indenture level coding of the 17 groups of data element hierarchies. The numbering of the indenture level is in correspondence with the level code.

- Class: The data element class indicates the manner in which the data element will be used in the data base and displayed during output requests. The class codes are:

  - M: A map field which points to a group of fields to be displayed by an output request.

  - S: A string or textual field which will be displayed left justified and broken at whole words for multiple lines of output.

  - I: An integer field that can be used in integer or floating point arithmetic expressions by the BASIS computational package and the statistical and modeling programs.

  - R: A real or floating point field that can be used in arithmetic expressions by the BASIS computational package and the statistical and modeling programs.

- Index: Each data element has been analyzed for the necessity of indexing to be used for record retrieval. The index codes are:

  - N: Not indexed

  - I: Indexed as a term that will be included in the inverted index file

  - R: Range indexed; numeric data elements can be searched by a retrieval request for all records containing a data element in a specified range.

- Search Level: The search level code indicates by a C1 or C2 the data elements that are designed to be used for satellite capability searching at level 1 or level 2.

- Design Level: The design level code indicates by a D1 or D2 the data elements that are designed to be used for satellite design searching at level 1 or level 2.

- Field: The field number is a numeric tag to identify each of the individual data elements that make up a data base record.

- Field Mnemonic: The field mnemonic is a textual tag to be used in BASIS computational expressions or in requests for display of data elements.

- Field Title: The field title is the identifier that will be printed by the BASIS output programs when the display of a field is requested.

The modes of searching the satellite catalog data base and the modes of use of data elements in computational expressions or in display requests is described in the next part of this section, BASIS System Capabilities.

D. BASIS System Capabilities

As discussed in Section III.B., the conceptual design of the data base system is founded on the utilization of the BASIS system. The BASIS system is an interactive, conversational system to be used on a time-sharing computer; it can also be used in batch mode.

The storage and retrieval capability of BASIS allows users who are not necessarily knowledgeable in computer programming to search large files. BASIS is a modular system that also allows the user to perform data analysis and data base management tasks. The BASIS system and data base files are operated and maintained on a 19 hour day on Battelle's CDC 6400 computer. Users may be located throughout the United States. Access to Battelle's computer is via standard telephone dial-up service or via a communication network for long distance economy.

In addition to Battelle's installation, BASIS has been installed at many sponsor organizations within the U.S. and several foreign countries. BASIS is operational on five different vendor computers: CDC 6000 series, UNIVAC 1108, SIGMA 9, DEC 10, and IBM 360, 370 series computers.

The BASIS system is similar in many respects to other on-line storage and retrieval systems. However, it provides a wide range of additional capabilities:

- Combined textual and numeric data retrieval and analysis
- On-line mathematical expression evaluation and statistical analysis
- Ability to execute external programs (OWNCODE) from BASIS
- Saved user procedures - PROFILE
- On-line sort
- On-line report generator
- On-line graphics (including storage tube and bidirectional terminals)
- On-line modeling
- Complete system interaction monitoring
- User aids and tutorial procedures
- On-line thesaurus
- Extremely fast retrieval for small and large files
- Sophisticated file creation and maintenance packages (including the ability to easily update very large files).

As indicated, an organization may choose to implement their data base files on Battelle's computer or acquire BASIS to operate on their own computer. Organizations selecting BASIS for implementation on their computer are always given close personal assistance by qualified individuals. This assistance includes:

- A determination of the organization's overall information needs
- Assistance in creating files
- Training of users
- Development of user guides
- Training of the data manager
- Training of systems programmers in the use of BASIS software
- Provision of documentation that includes source code listings of all BASIS modules.

An organization can choose to maintain BASIS with internal staff or have Battelle provide this support.

Careful design attention has been paid to insuring both the portability and modifiability of all BASIS software. Battelle is committed to an ongoing development of system capabilities. Users can be assured that BASIS will remain a state-of-the-art system and that its continued evolution will not render existing applications obsolete. Users who have chosen to install BASIS on their own computer do so with the knowledge that a change of computers, even to that of another vendor, will not require the complete redesign of the data base.

1. The BASIS Storage and Retrieval Module

The core system utilized by BASIS is the Storage and Retrieval Module, a highly sophisticated user oriented system widely known for its speed, flexibility, and ease of operation. The BASIS document file consists of unit records composed of data elements (or fields) of variable length and may have repeated occurrences. The specification of the data fields for the satellite catalog was described in Section III.C. A unique accession number is assigned as the

logical address of each record. BASIS index and range files use the accession number to reference the occurrence of key words, key word phrases, data values, and data value ranges.

BASIS is an interactive, conversational system which continually prompts the user and provides diagnostic messages. Requests to the storage and retrieval module fall into classes:

- Retrieval requests
- System commands.

Retrieval requests may utilize either the inverted index or the sequential search capability.

The Storage and Retrieval Module permits a random nonhierarchical search strategy. This offers a high degree of freedom in pursuing a complex, changing search strategy. An alternate hierarchical mode can be set on or off by the user at any time during the search session. Each retrieval request is entered one search key at a time. A retrieval request is one of two types:

- Index Term: A search key or term is a string of characters entered from the terminal requesting the set of records that contain that specific value. Index terms or keys are items of data, either text words or numeric data points or ranges. An index is constructed for these terms in a prespecified manner. Index terms and their corresponding accession numbers are compiled at file creation or update into an inverted index. This permits extremely fast retrieval of records having a single index term or Boolean combinations of terms, which may include general numeric data ranges. Access to the index is through a term entered by the user. In addition, records may be searched sequentially.

- Boolean Logic: BASIS assigns ascending line numbers as reference tags for retrieved record sets. Boolean logic statements may be utilized to combine these sets in a complex manner. Boolean operators used in this process include:

  - AND (abbreviated as A)
  - OR (abbreviated as O)
  - AND NOT (abbreviated as A N).

A list of index terms for the prototype satellite catalog data base is attached as Appendix G.

A sample BASIS search and retrieval is shown in Figure 6. This sample search illustrates

- Index term entry (e.g., TRAJC:LOW EARTH ORBIT as shown for line 11 of the sample search)
- Stem search entry: a stem request can be used without the index term limit parameter (e.g., PROJ:* as shown for line 1 of the sample search) or with an index term limit (e.g., PIF:*6 as shown for line 5 of the sample search)
- Stem selection options (e.g., ALL as shown for line 1; a group such as A TO D and G TO I as shown for lines 2 and 3 respectively; or enumeration of selected terms such as E,F as shown for line 2)
- Range term entry (e.g., PSPEOL:LT 200 as shown for line 8); ranges may be specified using:
  - LT for less than
  - LE for less than or equal
  - GT for greater than
  - GE for greater than or equal
  - EQ for equal
  - NE for not equal
  - TO for an inclusive range
- Boolean logic entry (e.g., (2 OR 3) as shown for line 4 or (10 AND 11) as shown for line 12).

To supplement the highly interactive inverted file search capability, BASIS provides a sequential file searching capability. There are three major benefits in the use of sequential searching:

- The ability to search record entries not specifically indexed
- The reduction in amount of disk storage needed for index files (since the sequential search need not rely on the BASIS index file for all search information)
- The ability to perform complex searches requiring more sophisticated character masking than possible with inverted file searching.

The component phrases of the sequential search request have the following syntax:

[field specification][relational operator][search term]...[search term].

FIGURE 6. SAMPLE BASIS SEARCH AND RETRIEVAL

```
BATTELLE INTERCOM 4.5
DATE  11/29/76
TIME  22.07.59.

PLEASE LOGIN
LOGIN,SEASAT,TEST,SUP,X

COMMAND- BASIS,RUN,BASIS3,CLAYDON,SEASAT
              B A S I S

ENTER YOUR REQUESTS ONE AT A TIME

.....................SAMPLE SEARCH.....
.........................STEM SEARCH.....
  1/ PROJ:*


  .ITEMS.    TERM
A        2  PROJ:ANIK 2
B        1  PROJ:COMSAT
C        1  PROJ:GMS
D        1  PPROJ:INTELSAT IV
E        1  PROJ:JAPANESE GEOSTATIONARY METEOROLOGICAL SATEL
F        1  PROJ:MARISAT
G        1  PROJ:ORBITING SOLAR OBSERVATORY
H        1  PROJ:OSO 1
I        2  PROJ:WESTAR
END OF TERMS WITH YOUR STEM
ENTER LETTERS TO BE COMBINED,
SEPARATED BY COMMAS, OR ALL
.........................SAMPLE ENTRIES...
  1/ ALL
         6 ITEMS
SELECT TERMS, OR ENTER YOUR REQUEST
  2/ A TO D,E,F
         5 ITEMS
SELECT TERMS, OR ENTER YOUR REQUEST
  3/ G TO I
         3 ITEMS
SELECT TERMS, OR ENTER YOUR REQUEST
.........................BOOLEAN LOGIC TERMS..
  4/ ( 2 OR 3 )
         6 ITEMS
.........................STEM WITH LIMIT..
  5/ PIF:*6


  .ITEMS.    TERM
A        5  PIF:APOGEE BOOST
B        2  PIF:ATTITUDE ADJUST
C        2  PIF:ATTITUDE ADJUSTMENT
D        1  PIF:ATTITUDE CONTROL
```

FIGURE 6. SAMPLE BASIS SEARCH AND RETRIEVAL (CONTINUED)

```
E       1  PIF:INITIAL SPIN-UP ADJUSTMENT
F       1  PIF:INITIAL SUN ACQUITION
ENTER  MORE  TO CONTINUE TERM LIST
ENTER LETTERS TO BE COMBINED,
SEPARATED BY COMMAS, OR ALL
  5/ ALL
         6 ITEMS
SELECT TERMS, OR ENTER YOUR REQUEST
  6/ MORE


  .ITEMS.    TERM
A       1  PIF:ORBIT ADJUST
B       2  PIF:ORBIT ADJUSTMENT
C       1  PIF:ORBIT CONTROL
D       1  PIF:SPIN AXIS ORIENTATION
E       1  PIF:SPIN SPEED CONTROL
END OF TERMS WITH YOUR STEM
ENTER LETTERS TO BE COMBINED,
SEPARATED BY COMMAS, OR ALL
  6/ ALL
         5 ITEMS
SELECT TERMS, OR ENTER YOUR REQUEST
  7/ ( 2 OR 3 )
         6 ITEMS
  8/ RESET
DO YOU WANT TO RESET SOME LINES?
   / NO
WHAT DO YOU WANT TO SET THE LINE NUMBER TO?
   / 7
  7/ END*RESET
ENTER YOUR REQUEST
  7/ ( 5 OR 6 )
         6 ITEMS
.......................RANGE TERMS.........
  8/ PSPEOL:LT 200
         0 ITEMS
  9/ PSPEOL:200 TO 400
         4 ITEMS
 10/ PSPEOL:GT 400
         2 ITEMS
.......................INDEX TERM.........
 11/ TRAJC:LOW EARTH ORBIT
         1 ITEM
 12/ ( 10 AND 11 )
         1 ITEM
```

Search terms may be literals containing actual values to be used in the search, data elements or portions of data elements, or literals in which some characters are not to be matched. This variety of search term forms gives the user an extremely flexible tool with which he may compare fields within documents, compare fields with actual data values, or compare fields with string patterns in which selected characters are to be matched. He may also specify where patterns must occur in the data element in order for the document to be selected. The relational operators available for use in sequential searching are:

EQ, IS, comma(,), or blank	- equal (universal match of characters may be specified by $ or ?; i.e., PIF EQ "ADJ"??? will match the appearance of "ADJUST" in field PIF)
NE, NOT	- not equal
GT	- greater than
LT	- less than
GE	- greater than or equal
LE	- less than or equal
BT	- between, endpoints included
BX	- between, endpoints excluded
AB	- data element absent
PR	- data element present
SCAN	- looks for one or more search terms anywhere in the data element
PREFIX, STEM	- tests the first characters of a data element and ignores the remainder
SAME SENTENCE	- same as SCAN except search terms must appear in the same sentence
{W = n / < n / > n}	- tests the number of words separating two search terms where n is an integer (when n is zero, the search terms must be adjacent).

A sample sequential file search is shown in Figure 7. This sample illustrates

- Sequential search specifications: the specifications are initiated by the system command SEARCH SEQUENTIAL and are terminated by a BASIS command (e.g., ABORT is shown in the sample as the specification terminator); each specification is provided a unique tag by BASIS

FIGURE 7. SAMPLE BASIS SEQUENTIAL SEARCH AND RETRIEVAL

```
.........................SAMPLE SEQUENTIAL SEARCH.....
.............................SEARCH SPECIFICATIONS...
 13/ SEARCH SEQUENTIAL
ENTER SEQUENTIAL SEARCH SPECIFICATION
 A1 /ACJG IS "NITROGEN"
 A2 /ABORT
ENTER YOUR REQUEST
 13/ SEARCH SEQUENTIAL
ENTER SEQUENTIAL SEARCH SPECIFICATION
 B1 /PROPULSION SCAN "ATTITUDE"
 B2 /PROPULSION SCAN "SPIN"
 B3 /PROPULSION SCAN "ADJUST"????
 B4 /PROPULSION W<2 "APOGEE", "BOOST"
 B5 /ABORT
ENTER YOUR REQUEST
 13/ SEARCH ON 1 USING A,B1,B3,B4          .........SEARCH REQUEST....
THE SEARCH CAN BE COMPLETED IN A SINGLE PASS OVER THE DOCUMENT
SET UNDER LINE 1   WHICH CONTAINS 6       DOCUMENTS, THE
FOLLOWING SEARCH LINES WILL BE RETRIEVED

TAG       TEXT

A1        ACJG IS "NITROGEN"
B1        PROPULSION SCAN "ATTITUDE"
B3        PROPULSION SCAN "ADJUST"$$$$
B4        PROPULSION W<2 "APOGEE", "BOOST"

SHALL I PROCEED WITH PASS 1 .  ENTER YES OR NO.
   / YES                                  .........SEARCH EXECUTION....

PASS  1 COMPLETED, THE FOLLOWING RESULTS HAVE BEEN SAVED FROM
THE SEARCH ON LINE 1

 TAG LINE   REQUEST

 A1   13/  ACJG IS "NITROGEN"
                1 ITEM
 B1   14/  PROPULSION SCAN "ATTITUDE"
                5 ITEMS
 B3   15/  PROPULSION SCAN "ADJUST"$$$$
                5 ITEMS
 B4   16/  PROPULSION W<2 "APOGEE", "BOOST"
                5 ITEMS
END OF SEQUENTIAL SEARCH
 ..............................DISPLAY OF RETRIEVED RECORDS.....
ENTER YOUR REQUEST
 17/ DISPLAY 13

WHAT FIELDS DO YOU WANT TO SEE?
ENTER FIELD NUMBERS SEPARATED BY COMMAS OR ALL
   / MECHANISM
```

FIGURE 7. SAMPLE BASIS SEQUENTIAL SEARCH AND RETRIEVAL (CONTINUED)

```
ITEM 1

CONTROL MECHANISM : GAS JET
CONTROL MECH, JET GAS : NITROGEN
CONTROL MECH, JET SIZE : 0.4 LB

DO YOU WANT TO ENTER ANOTHER EXPRESSION?
   / NO

FINISHED WITH PRINT OUT
ENTER YOUR REQUEST
 17/ DISPLAY

WHAT FIELDS DO YOU WANT TO SEE?
   / PROPULSION
THIS PRINTOUT MAY BE LENGTHY
         5 ITEMS
HOW MANY ITEMS DO YOU WANT FIRST?
   / 1

ITEM 1

PROP, IN-ORBIT FUNCTIONS : ORBIT ADJUSTMENT
PROP, IN-ORBIT CAP, FUEL : HYDRAZINE
PROP, IN-ORBIT CAP, DELTA V : 426 M/S
PROP, IN-ORBIT, MFGR : HUGHES AIRCRAFT CO.
PROP, IN-ORBIT FUNCTIONS : ATTITUDE ADJUSTMENT
PROP, IN-ORBIT CAP, FUEL : HYDRAZINE
PROP, IN-ORBIT CAP, DELTA V : 426 M/S
PROP, IN-ORBIT, MFGR : HUGHES AIRCRAFT CO.
PROP, IN-ORBIT FUNCTIONS : APOGEE BOOST
PROP, IN-ORBIT CAP, FUEL : SOLID
PROP, IN-ORBIT CAP, DELTA V : 1850 M/S
PROP, IN-ORBIT, MFGR : UTC (FW-5)
DO YOU WANT TO SEE MORE?
   / NO

DO YOU WANT TO ENTER ANOTHER EXPRESSION?
   / NO

FINISHED WITH PRINT OUT
ENTER YOUR REQUEST
 17/
```

- Sequential search request: the search request is initiated by the BASIS command SEARCH ON < line number > USING < sequential search tag(s) > where
  - < line number > is the BASIS line number of the set of records to be searched sequentially
  - < sequential search tag(s) > is a list of tags indicating which sequential search specifications are to be utilized

- Sequential search execution: for each pass of the set of records to be sequentially searched, the user must answer "YES" or "NO" (e.g., lines 13 through 16 of the sample illustrate retrievals performed by BASIS sequential searching).

It should be noted that a mapped field (a collection of fields) can be sequentially searched (e.g., in the sample the mapped field PROPULSION, a collection of fields for in-orbit propulsion capability, is searched using the operators SCAN and W).

2. BASIS System Commands

In addition to the above-mentioned retreival requests, the user may select from a full range of system commands. System commands allow the user to request tutorial assistance, interrogate and dynamically modify system parameters, perform utility functions, control the execution of modules outside of the storage and retrieval module (including OWNCODE), and save complex dialogs to be run later.

a. TEACH. TEACH provides for an interactive user-system dialog which explains (with appropriate examples) the various features available. When the user enters TEACH, the system will list available features and ask the user to select one for detailed explanation. The description provided includes instructions and examples to clarify the BASIS capability. The dialog may be addressed to specific data base applications since the TEACH command is data base dependent.

b. DISPLAY, DEFINE, PRINT. A retrieved set of records may be selectively displayed or may be utilized in computational expressions; the results can be (1) displayed using the DISPLAY command, (2) saved internal to the system through a defined variable using the DEFINE command, or (3) printed off-line using the PRINT command. The computational language (COMP) allows the use of the operators and functions shown in Figure 8. The syntax of the DISPLAY command is "DISPLAY

FIGURE 8. THE COMPUTATIONAL OPERATORS AND FUNCTIONS

Boolean Operators

.NOT.	.AND.	.OR.

Relational Operators

.GT.	(greater than)	.LT.	(less than)	.EQ.	(equal to)
.GE.	(greater than or equal to)	.LE.	(less than or equal to)	.NE.	(not equal to)

Arithmetic Operators

+ (add)	* (multiply)	** (exponentiation)
- (subtract)	/ (divide)	

Common Functions

LOG	($\log_e$)	MIN	(minimum)	SUM	(sum)
LOG10	($\log_{10}$)	MAX	(maximum)	CUM	(cumulate)
EXP	(base e)	AVG	(average)	DECUM	(decumulate)
ABS	(absolute)	STD	(standard deviation)	LREG	(linear regression)
VAL	(value of defined variable from next or previous records)				

n" or "DISPLAY" where n is the record set line number. It defaults to the last line number retrieved. The syntax for the DEFINE and PRINT commands is the same as for DISPLAY. In response to the DEFINE command the BASIS system issues the message "WHAT FIELDS DO YOU WANT TO SEE?" followed by a "/" to solicit user response. An expression may be a simple request to display the contents of a record entry (field) or a complex computational relationship utilizing the full scope of computational operators and functions. Sample usage of the computational language with the DEFINE command is shown in Figure 9. The displayed results are printed in a general format which may be modified using the SET command (e.g., set heading off to eliminate annotative headings).

The syntax of the COMP language is similar to standard FORTRAN, but knowledge of computer programming is not required. Computational expressions are separated by commas. Expressions are comprised of entry (field) mnemonics or numbers, defined variables, and literals (constant values) in conjunction with COMP operators and functions. Entry (field) mnemonics or numbers reference the contents of a record entry (field). Defined variables are expressions that have been evaluated and assigned names (the syntax is: name = expression). The syntax for literals is: "constant". When an expression is evaluated, the BASIS system accesses each record of the retrieved set, obtains from each record the values of required record entries and defined variables, performs the requested operations and functions, and disposes of the results (by displaying, printing, or saving).

The class of expressions accommodated by the COMP module are:

- Integer (maximum magnitude determined by hardware)
- Floating point (maximum magnitude determined by hardware)
- Logical (true and false values)
- String (full range of character set).

Defined variable names may be assigned to any class of expression.

FIGURE 9. SAMPLE USAGE OF DEFINE AND DISPLAY

```
  1/ TRAJC*ALL
        6 ITEMS
     2 TERMS WITH YOUR STEM WERE COMBINED
  2/ DEFINE

WHAT FIELDS DO YOU WANT TO SEE?
ENTER FIELD NUMBERS SEPARATED BY COMMAS OR ALL
   / XM=MAX(PAP)

DO YOU WANT TO ENTER ANOTHER EXPRESSION?
   / XCOUNT=SUM("1")

DO YOU WANT TO ENTER ANOTHER EXPRESSION?
   / X=CUM("1.")*XM/XCOUNT,Y1="275."+"1.1"*X,Y2="1.1"*X

DO YOU WANT TO ENTER ANOTHER EXPRESSION?
   / NO

FINISHED WITH PRINT OUT
ENTER YOUR REQUEST
  2/ RUN SAR(EDIT)
ENTER EDIT COMMAND
   / ITEMIZE,ALL

LINE  VARIABLE    TYPE      VALUES  NULLS  CHAR(MAX)
-------------------------------------------------
  1   XM          REAL           1      0      ---
  1   XCOUNT      INTEGER        1      0      ---
  1   X           REAL           6      0      ---
  1   Y1          REAL           6      0      ---
  1   Y2          REAL           6      0      ---
ENTER EDIT COMMAND
   / STOP
ENTER YOUR REQUEST
  2/ LIST VARIABLES


SEQ. LINE  VARIABLE AND DEFINITION
  1   1    XM=MAX(PAP)
  2   1    XCOUNT=SUM("1")
  3   1    X=CUM("1.")*XM/XCOUNT,
  4   1    Y1="275."+"1.1"*X,
  5   1    Y2="1.1"*X
ENTER YOUR REQUEST
  2/ DISPLAY

WHAT FIELDS DO YOU WANT TO SEE?
   / XM, XCOUNT
XM, =                                          415.000
 XCOUNT =                                            6

DO YOU WANT TO ENTER ANOTHER EXPRESSION?

   /  NO

FINISHED WITH PRINT OUT
ENTER YOUR REQUEST
```

The evaluation of expressions may be qualified by use of the computational IF statement. Using e_i to symbolize the i_{th} expression (including defined variable expressions), the syntax of the IF statement is:

IF logical expression THEN e_1, e_2,...,e_i ELSE e_{i+1}, e_{i+2},...;

Note that the expression immediately following IF must be a logical class expression; any other expression, e_i, may be of any class.

COMP Operators. The three categories of operators available for use in the COMP language are:

- Boolean
- Relational
- Arithmetic.

The operators are shown in Figure 8. The periods on each end of the alphabetic symbol are required for Boolean and relational operators. The arithmetic operators can be used only in conjunction with numeric (integer and floating point) operands. The relational operators can be used in conjunction with any class of expression, but the present implementation of COMP recognizes only .EQ. or .NE. for comparisons of string or logical expressions. String expressions may utilize only the relational operators (bit manipulation using .AND. and .OR. is not implemented). For the Boolean operators the operands must be logical expressions. Any expression utilizing Boolean or relational operators is of logical class. Mixed numeric class expressions are allowed by the COMP language, but the resultant expression will be of floating point class. An expression involving only integers and arithmetic operators will be classed as integer. The user should be aware of the consequences of integer arithmetic; for example, the integer expression "7"/"8" has the integer value "0".

COMP Functions. Except for the VAL function, all of the functions of the COMP language are of numeric class. Most of the numeric functions shown in Figure 8 are familiar to potential system users, with the exception of two unusual numeric functions CUM and DECUM. CUM is used to cumulate the values of an expression (e.g., cumulative dosage of toxic drug); DECUM is the inverse of CUM and could be used to calculate difference for a cumulated expression. Except

for the function LREG, numeric functions use a single parameter. The parameter can be any numeric expression (i.e., a defined variable, entry mnemonic or number, or any complex expression utilizing operators and functions). The functions LOG, LOG10, EXP, ABS, CUM, and DECUM produce a value for every record processed. The functions MIN, MAX, AVG, SUM, and STD are standard descriptive statistical functions and produce one value for the entire set of records. The LREG function for simple linear regression utilizes two parameters:

- Parameter 1: the independent variable
- Parameter 2: the dependent variable.

Each of these parameters may be any numeric expression.

c. PROFILE (Saved Procedure). Because of the recurring nature of many functions performed within some BASIS modules, the system provides a capability called PROFILE that allows a user to save search statements, display requests, computational expressions, logic statements, and all other repetitive user text. The user may delete or modify profiles in batch or interactive mode using the PROFILE editor. The saved profile can contain variable expressions to be entered by the user at search time. Any BASIS dialog can be saved in a profile and profiles can be linked to permit one to execute others (profile nesting). Sample profile usage is shown in Figure 10 and Appendices H and I.

Profile Creation. A user may create a profile in capture mode by entering "PROFILE CREATE ON" or "SET PROFILE ON", or in editor mode. The created profile is terminated and named by entry of the command "PROFILE SAVE name", where name is a user supplied name of 30 characters or less which may contain any characters but "["and"]"; the first word of the name may not be a BASIS system command.

Profile Execution. Once saved, a profile may be executed by the "PROFILE EXECUTE name" command where name is spelled and punctuated exactly as when saved.

Profile Parameters. Some of the text of a profile may be left unspecified until execution time. During profile creation, all text parameters are indicated by "[message]" where message can be any string of ten or less characters

FIGURE 10. SAMPLE USAGE OF PROFILE

```
.............................SAMPLE OF SAVING A PROFILE.....
ENTER YOUR REQUEST
 18/ SET PROFILE ON
ENTER YOUR REQUEST
 18/ TELL(.......SAMPLE OF A SEARCH TERM PROFILE USING PARAMETERS...)
.......SAMPLE OF A SEARCH TERM PROFILE USING PARAMETERS...
ENTER YOUR REQUEST
 18/ [FIELD]:[DATA VALUE]*ALL
               FIELD ? PIF
          DATA VALUE ? ATTITUDE
         5 ITEMS
      3 TERMS WITH YOUR STEM WERE COMBINED
 19/ PROFILE SAVE SAMPLE SEARCH TERM PROFILE
.............................SAMPLE OF PROFILE EXECUTION
ENTER YOUR REQUEST
 19/ PROFILE EXECUTE SAMPLE SEARCH TERM PROFILE


THE FOLLOWING ARE PARAMETERS TO BE SATISFIED
               FIELD ? PIF
          DATA VALUE ? ORBIT
.......SAMPLE OF A SEARCH TERM PROFILE USING PARAMETERS...
 19/ PIF:ORBIT*ALL
         4 ITEMS
      3 TERMS WITH YOUR STEM WERE COMBINED
 20/  PROFILE SHOW SAMPLE SEARCH TERM PROFILE
DATE CREATED ON :  11/01/76
      AUTHOR     : SEASAT
FILE LOCATED IN : SAVE FILE
   5 = TELL(.......SAMPLE OF A SEARCH TERM PROFILE USING PARAMETERS...)
  10 = [FIELD]:[DATA VALUE]*ALL
CONTINUE
```

(except "[" and "]"). Multiple parameters per line of entry text are allowed. Parameters having the same name are assumed identical and the system will request entry only once.

Profile Showing. To view the profile table of contents, the user enters the command "PROFILE SHOW". To view the text of a particular profile the command "PROFILE SHOW name" is entered, where name is spelled and punctuated exactly as when saved.

Profile Commands. Commands that have special importance within profiles are:

- TELL (message)
- ASK (message)
- WAIT.

Message is a line of text of 60 characters or less that is issued by the system when one of the above commands is encountered. The TELL command is used to provide information only, the ASK command is used to solicit user response, and the WAIT command is used to allow the system to pause until user reponse (any entry) is received by the system.

d. SET. The SET command provides the user with optional control over BASIS functions. A figure in Section III.D.2.e. shows the parameters that may be SET. Use of the LIST STATUS command will display the current status (values) of the SET parameters. The SET command may be followed by a series of parameter key words and parameter values delimited by a blank or equal sign. Keyword/value pairs are delimited by a blank or comma. If an incorrect response is entered, BASIS issues the seris of messages "EXAMPLE OF CORRECT FORM FOR SET", "LINE=40, PRLINE=100,PAGE=ON", "ENTER PARAMETERS AND VALUES" followed by a "/".

Most of the SET parameters control output format for the DISPLAY or PRINT commands. TRLINE and PRLINE set the maximum line length for printing on an interactive terminal and batch printer respectively. SEQ and FIELD, are used to set usage of sequence or field (entry) headings on or off. ITEM is used to turn on or off the printing of the record count within DISPLAYed or PRINTed output. UNIT and THES are used for printing the unit of measure for entry (field) values

and for thesaurus usage respectively. ADJAC is used for setting the number of index terms to be printed for terms adjacent to a search entry for which no index term exists. PAUSE is used to set the number of records to DISPLAY, DEFINE, or PRINT before pausing to ask if the user wishes to continue with the output. PAGE is used to set on or off the message that a requested output may be lengthy. PROFILE is used to set profile capture mode on or off for creating a profile. UNIVERSE is used to limit searching to the set of records indicated by the line number parameter. HIERARCHY is used for a hierarchical search (i.e., for each search the universe is the last retrieved set of records). A sample of a hierarchical search is shown in Figure 11.

e. LIST. The LIST command allows the user to list:

- Line numbers and corresponding search terms for retrieved record sets
- BASIS commands and a brief description of their function
- Parameters that may be utilized with a SET command
- The status (values) of the SET parameters
- Defined variable names, line numbers, and definitions.

Sample usage of the LIST command is shown in Figure 12.

f. XEQ,RUN. To facilitate the highly modular design of BASIS, a special loading program swaps systems modules. The RUN command is used to swap independent BASIS modules into computer memory. The XEQ command is used to call other software from the system library or user supplied OWNCODE. Sample usage of the XEQ and RUN commands is shown in Figure 13.

g. ABORT. One of the central design concepts of the BASIS system is to allow the user complete freedom to choose and modify his strategy. The ABORT command allows the user to immediately stop the execution of a BASIS command or supporting system module like the SAR Module. Upon entry of ABORT whenever input

FIGURE 11. SAMPLE USAGE OF SET

```
  1/ SET HIERARCHY ON
ENTER YOUR REQUEST
  1/ TRAJC*ALL
         6 ITEMS
      2 TERMS WITH YOUR STEM WERE COMBINED
.........................HIERARCHICAL SEARCH.....
  2/ PIF:APOGEE BOOST
         5 ITEMS
 IN YOUR DATA SUBSET
  3/ PSPEOL:250 TO 450
         3 ITEMS
 IN YOUR DATA SUBSET
  4/ ST:*


  .ITEMS.     TERM
 IN YOUR DATA SUBSET
A        1  ST:NO SCIENCE PAYLOAD
B        1  ST:UHF, C-BAND, L-BAND TRANSPONDERS
END OF TERMS WITH YOUR STEM
ENTER LETTERS TO BE COMBINED,
SEPARATED BY COMMAS, OR ALL
  4/ B
         1 ITEM
 IN YOUR DATA SUBSET
SELECT TERMS, OR ENTER YOUR REQUEST
  5/ DISPLAY

WHAT FIELDS DO YOU WANT TO SEE?
   / PROJ

ITEM 1

PROJECT NAME : MARISAT

DO YOU WANT TO ENTER ANOTHER EXPRESSION?
   / PAYLOAD

ITEM 1

PAYLOAD CLASS : COMMUNICATIONS
WT., SENSOR PAYLOAD : 68 KG
SENSOR TYPE (EXPERIENCE) : NO SCIENCE PAYLOAD; UHF, C-BAND, L-BAND
    TRANSPONDERS
STOWED DIMEN., DIAMETER : 216 CM
STOWED DIMEN., LENGTH : 381 CM

DO YOU WANT TO ENTER ANOTHER EXPRESSION?
   / NO

FINISHED WITH PRINT OUT
ENTER YOUR REQUEST
  5/ SET HIERARCHY OFF
ENTER YOUR REQUEST
```

FIGURE 12. SAMPLE USAGE OF LIST

```
ENTER YOUR REQUEST
 18/ LIST

  .ITEMS. LINE      REQUEST
*       6   1/  PROJ:(STEM) ALL
*       5   2/  PROJ:(STEM) A TO F
*       3   3/  PROJ:(STEM) G,H,I
*       6   4/  ( 2 OR 3 )
*       6   5/  PIF:(STEM) ALL
*       5   6/  PIF:(STEM)[ 2] ALL
*       6   7/  ( 5 OR 6 )
*       0   8/  PSPEOL:LT 200
*       4   9/  PSPEOL:200 TO 400
*       2  10/  PSPEOL:GT 400
*       1  11/  TRAJC:LOW EARTH ORBIT
*       1  12/  ( 10 AND 11 )
*       1  13/   A1  ACJG IS "NITROGEN"
*       5  14/   B1  PROPULSION SCAN "ATTITUDE"
*       5  15/   B3  PROPULSION SCAN "ADJUST"$$$$
*       5  16/   B4  PROPULSION W<2 "APOGEE", "BOOST"
*       6  17/  TRAJC*ALL
ENTER YOUR REQUEST
 18/ LIST COMMANDS
BASIS COMMANDS USED IN SEASAT

DISPLAY SHOW SOURCE FILE DATA ONLINE
PRINT   SHOW SOURCE FILE DATA OFFLINE
LIST    SHOW LINES USED IN SEARCH OR
        COMMANDS,PARAMETERS,STATUS
        VARIABLES,DESCRIBE
SET     CHANGE VARIOUS PARAMETERS
        FOR MORE INFORMATION ENTER:  LIST PARAMETERS
QUIT,END   TERMINATE THE USAGE OF BASIS
LOGOUT  TERMINATE USAGE OF BASIS
        AND THE COMPUTER SYSTEM
RESTART START THE USE OF BASIS FROM
        THE BEGINNING AGAIN
PROFILE INITIATE THE USE OF THE PROFILE SUB-SYSTEM
RUN     EXECUTE USER OWNCODE PROGRAMS
XEQ     EXECUTE INTERCOM COMMANDS AND RETURN TO BASIS
DEFINE  DEFINE VARIABLES FOR FUTURE USE
ABORT   ABORT PRESENT FUNCTION AND RETURN TO SEARCHING
CLOCK   SHOW TIME USED SO FAR
EXPLAIN EXPLAIN THE LAST MESSAGE
ALSO:   RESET,SEARCH
        ASK,TELL,WAIT,.OUTPUT.,SEE,ENT
ENTER YOUR REQUEST
```

FIGURE 12. SAMPLE USAGE OF LIST
(CONTINUED)

```
ENTER YOUR REQUEST
 18/ LIST VARIABLES


SEQ. LINE  VARIABLE AND DEFINITION
  1    1    XM=MAX(PAP)
  2    1    XCOUNT=SUM("1")
  3    1    X=CUM("1.")*XM/XCOUNT,
  4    1    Y1="275."+"1.1"*X,
  5    1    Y2="1.1"*X
  6   17    XM=MAX(PAP)
  7   17    XCOUNT=SUM("1")
  8   17    X=CUM("1.")*XM/XCOUNT,
  9   17    Y1="275."+"1.1"*X,
 10   17    Y2="1.1"*X
ENTER YOUR REQUEST
 18/ LIST PARAMETERS

PARAMETERS THAT CAN BE SET :

PROFILE SET PROFILE CREATE ON/OFF
ADJAC   NUMBER OF ADJACENT TERMS TO SHOW
UNIV    SET SEARCHING TO A SUBSET OF THE DATA BASE
        UNIV=1 , MEANS USE THE SUBSET DEFINED BY LINE 1 FOR
        SEARCHING
DISPOSE  FOR ROUTING OF OFF-LINE PRINT FILE TO REMOTE PRINTERS
        DISPOSE=XX  DISPOSE TO REMOTE PRINTER WITH ID XX
                   (EACH REMOTE PRINTER HAS A TWO CHARACTER ID)
        DISPOSE=ON  FOR USERS AT A 200 UT, DISPOSE TO THEIR
                    PRINTER
        DISPOSE=OFF DO NOT DISPOSE THE PRINT FILE
        DISPOSE=C   DISPOSE TO PRINTER AT BATTELLE (DEFAULT)
TRLINE  ON-LINE TERMINAL LINE LENGTH
PRLINE  OFF-LINE PRINTER LINE LENGTH
INDENT  INDENTATION OF ADDITIONAL LINES FOR FIELDS
        WITH SEVERAL LINES OF OUTPUT
FIELD   SET FIELD NUMBERS ON/OFF
SEQ     SET SEQUENCE NUMBERS ON/OFF
HEAD    SET HEADINGS ON/OFF
UNIT    SET UNITS ON/OFF
PAGE    SET PAGING ON/OFF
ITEM    SET RECORD COUNT ON/OFF
SUP     SUPPRESS SHOWING UNIV ITEM COUNT IN TERM LISTS ON/OFF
LINKS   USE OF LINKS ON/OFF
HIER    HIERARCHICAL SEARCHING MODE ON/OFF
WARN    SEQ. SEARCH WARNING MESSAGE ON/OFF
PAUSE   PAUSE IN DISPLAY OF DATA COUNT
VALUES  SET USE OF DEFINED VARIABLE VALUES ON/OFF
        OFF MEANS RECALCULATE DEFINED VARIABLES
ALSO :  DEBUG AND ATTACH
ENTER YOUR REQUEST
```

FIGURE 13. SAMPLE OF XEQ AND RUN

```
 17/ ( 13 OR 14 )
        6 ITEMS
 18/ RUN SORT(PSPEOL)


BEGIN BASIS SORT
 18/ ( 13 OR 14 ) **SORTED**
        6 ITEMS
ENTER YOUR REQUEST
 19/ SET ITEM OFF
ENTER YOUR REQUEST
 19/ DISPLAY

WHAT FIELDS DO YOU WANT TO SEE?
   / PSPEOL
PSP, END OF LIFE : 212 W (SUMMER SOLSTICE)
PSP, END OF LIFE : 250 W (SUMMER SOLSTICE)
PSP, END OF LIFE : 250 W (SUMMER SOLSTICE)
PSP, END OF LIFE : 305 W (AFTER 5 YRS)
PSP, END OF LIFE : 402 W
PSP, END OF LIFE : 600 W

DO YOU WANT TO ENTER ANOTHER EXPRESSION?
   / NO

FINISHED WITH PRINT OUT
ENTER YOUR REQUEST
 19/ RUN SAR(EDIT)
ENTER EDIT COMMAND
   / ITEMIZE ALL

LINE  VARIABLE    TYPE     VALUES  NULLS  CHAR(MAX)
-------------------------------------------------
ENTER EDIT COMMAND
   / STOP
ENTER YOUR REQUEST
 19/ XEQ,FILES
--LOCAL FILES--
 *SAVEPFL  *BASIS3   $INPUT    $OUTPUT    PRINT
 *PROFILE   BACK     *SAR3     *SORT3
ENTER YOUR REQUEST
```

is solicited, system control will be transferred to the BASIS Storage and Retrieval Module and a prompting message "ENTER YOUR REQUEST" will be issued followed by line number and a "/" for input solicitation. Sample usage of the ABORT command is shown in Figure 14.

h. RESET. The RESET command is used to reset line numbers associated with retrieved record sets. For example, one could discard lines 1 through 4; reset lines 5 and 6 as new line numbers 1 and 2; set the line number for the next retrieved record set to 3. Note that when the LIST command is used to list retrieval terms, the annotation "*RESET*" is appended to the line to remind the user of the reset.

The RESET command can be used to:

- Discard erroneously retrieved sets of records
- Discard preliminary component record sets while keeping the final record set
- Change the line number order of sets of retrieved records.

These uses are "house cleaning" operations since the occurrence of unwanted record sets or the order of occurrence is of little importance, except that the limit of 99 sets of retrieved records may be avoided by discarding unused line numbers. Sample usage of the RESET command is shown in Figure 15.

i. RESTART, QUIT, LOGOUT. The RESTART command facilitates the change of one data base to another. The BASIS system will issue the messages "READY TO START AGAIN", "PLEASE ENTER THE NAME OF THE DATA BASE YOU WANT" and will solicit a response with a "/". After selection of the data base, the BASIS system will request the user to "PLEASE ENTER YOUR DATA BASE PASSWORD" if a security password is required for the data base. The QUIT and LOGOUT commands enable the user to terminate his usage of the BASIS system. When using QUIT, system control is returned to the host operating system and the user is responsible for ending the terminal session. The use of BASIS command LOGOUT will both exit BASIS and end the terminal session. LOGOUT provides only connect time, while QUIT allows the user to obtain whatever statistics are provided by the host system. Sample usage of the RESTART, QUIT, and LOGOUT commands is shown in Figure 16.

FIGURE 14. SAMPLE USAGE OF ABORT

```
 17/ RUN SAR(EDIT)
ENTER EDIT COMMAND
   / ABORT
 17/ ABORT
ENTER YOUR REQUEST
 17/ SEARCH SEQUENTIAL
ENTER SEQUENTIAL SEARCH SPECIFICATION
 C1 /ABORT
ENTER YOUR REQUEST
 17/ RUN SORT
ENTER SORT SPECIFICATION
   / ABORT
 17/ ABORT
ENTER YOUR REQUEST
 17/ SET
ENTER PARAMETERS AND VALUES
   / ABORT
ENTER YOUR REQUEST
 17/ RESET
DO YOU WANT TO RESET SOME LINES?
   / ABORT
 17/
```

FIGURE 15. SAMPLE USAGE OF RESET

```
ENTER YOUR REQUEST
 17/ LIST                          .............LIST OF RETRIEVALS......

  .ITEMS. LINE      REQUEST
*      6   1/  PROJ:(STEM) ALL
*      5   2/  PROJ:(STEM) A TO F
*      3   3/  PROJ:(STEM) G,H,I
*      6   4/  ( 2 OR 3 )
*      6   5/  PIF:(STEM) ALL
*      5   6/  PIF:(STEM)[ 2] ALL
*      6   7/  ( 5 OR 6 )
*      0   8/  PSPEOL:LT 200
*      4   9/  PSPEOL:200 TO 400
*      2  10/  PSPEOL:GT 400
*      1  11/  TRAJC:LOW EARTH ORBIT
*      1  12/  ( 10 AND 11 )
*      1  13/   A1  ACJG IS "NITROGEN"
*      5  14/   B1  PROPULSION SCAN "ATTITUDE"
*      5  15/   B3  PROPULSION SCAN "ADJUST"$$$$
*      5  16/   B4  PROPULSION W<2 "APOGEE", "BOOST"
ENTER YOUR REQUEST
 17/ RESET                         .............SAMPLE OF RESET..........
DO YOU WANT TO RESET SOME LINES?
   / 1=9,2=10,3=11,4=12,5=16,6=7

LINE 1  RESET AS LINE 9  WAS DEFINED
LINE 2  RESET AS LINE 10 WAS DEFINED
LINE 3  RESET AS LINE 11 WAS DEFINED
LINE 4  RESET AS LINE 12 WAS DEFINED
LINE 5  RESET AS LINE 16 WAS DEFINED
LINE 6  RESET AS LINE 7  WAS DEFINED
DO YOU WANT TO RESET MORE LINES?
   / NO
WHAT DO YOU WANT TO SET THE LINE NUMBER TO?
   / 7
ENTER YOUR REQUEST
  7/ LIST                            .............LIST OF RESET LINES.......

  .ITEMS. LINE      REQUEST
*      4   1/  PSPEOL:200 TO 400 *RESET*
*      2   2/  PSPEOL:GT 400 *RESET*
*      1   3/  TRAJC:LOW EARTH ORBIT *RESET*
*      1   4/  ( 10 AND 11 ) *RESET*
*      5   5/   B4  PROPULSION W<2 "APOGEE", "BOOST" *RESET*
*      6   6/  ( 5 OR 6 ) *RESET*
ENTER YOUR REQUEST
```

FIGURE 16. SAMPLE USAGE OF RESTART, QUIT, LOGOUT

```
ENTER YOUR REQUEST
  5/ RESTART                    .............SAMPLE OF RESTART.........


READY TO START AGAIN
PLEASE ENTER THE NAME OF THE DATA BASE YOU WANT
    / SEASAT

ENTER YOUR REQUESTS ONE AT A TIME
  1/ TRAJC*ALL
         6 ITEMS
      2 TERMS WITH YOUR STEM WERE COMBINED
  2/ QUIT                       .............SAMPLE OF QUIT............

GOODBYE
COMMAND- BASIS,RUN,BASIS3,CLAYDON,SEASAT

              B A S I S

ENTER YOUR REQUESTS ONE AT A TIME
  1/ LOGOUT                     .............SAMPLE OF LOGOUT..........

CONNECT TIME 0 HRS. ** MIN.

GOODBYE
```

3. Monitoring and Accounting

To provide detailed information on the usage of the BASIS System, Battelle supports an elaborate monitor module. This module is designed to supply information about capabilities used by an individual and the time at which each was used. The Monitor module generates a record for a particular session including:

(a) Name of user and data base(s) accessed

(b) Elapsed time of total search

(c) BASIS capability used with indication of the nature of the system response (wall clock time is given for all occurrences)

(d) Other information about internal "states" of the BASIS system for each user action.

a. The Set of User/System States Monitored. One of the greatest problems in describing the person-computer interaction is in the careful choice of states that each participant of the interaction can be in. In other person-machine studies the states for the person and machine are presumed to be necessarily identical. Such descriptive states are often more oriented to the computer than to the human and obscure much of the psychology of person-computer interaction. The states should not only be exhaustive, mutually exclusive, and ambiguous but interesting. The states currently controlled by the Monitor module may be changed to fit the particular needs of the data base.

The eleven states selected for analysis of the person-computer interaction are defined as:

(1) Begin Session - user initiates a session with the BASIS interactive retrieval system

(2) Request Data Base - user selectes a file to search via the BASIS system

(3) Search Index - user enters an index term, a word stem, an author's name, or any other characteristic in order to determine if such a term is in the index and, if so, the amount of information available related to that term. This function is an analog to establishing a common vocabulary between conversants and is a form of browsing or associative conversation.

(4) Logic Formulation - user couples search terms in a logical combination (and,or,not) to build up sets of potentially relevant documents. This process is analogous to formulating a problem statement or a hypothesis.

(5) Off-Line Print - user requests documents printed out off-line for later review. Such a function would be performed generally when the problem statement has been tested and shown to be accurate or when the number of potentially relevant documents is quite large.

(6) On-Line Print - user browses documents while at the terminal to determine if the problem statement accurately reflects his real informaiton needs when translated into system content. This function is a form of hypothesis testing.

(7) Review Search - user refers back to his previous actions involving index searching and logic information.

(8) Review Commands - user requests information on the command language of the BASIS system. This can be viewed as meta communication in that the user is asking the system about its communication capabilities and may be requesting a tutorial.

(9) Set Parameters - user modifies the various output features of the system including line length, page size, window around subject terms in adjacent term options, or length of term list in stem searching.

(10) Exit Data Base - user completes search in a file. He may request another file (i.e., converse with another source of information) or terminate the session.

(11) End Session - user terminates BASIS session. This may involve actually disconnecting from the computer or merely switching to some other computer program available on the system.

An alternative four-state model may also be used. This model consists of three major states: (1) index search, (2) logic formation, and (3) on-line print or document display plus a fourth category including all other states. This condensed model emphasizes the three major components of information processing.

b. Analysis of Monitor Data. The Monitor data can be used to study data base usage, command usage, and to determine the criteria for changing (adding or deleting) elements of the data base. The user and/or application's programmer can use Monitor module data to optimize file access structures. For example, it may be observed that users never or very infrequently utilize index or range terms for some categories of data base entries. Such terms may be eliminated from the index, and if needed, retrieved sequentially. The information generated by the Monitor module can be accessed by (1) a user supplied program, (2) Battelle supplied programs via the BASIS RUN command, or (3) by BASIS if the Monitor file is loaded for BASIS using the Data Definition Language (DDL) of the File Maintenance Module.

Given the basic eleven states as defined for person-computer interaction, Battelle has developed a series of computer programs for reduction and analysis of the large quantity of data. The basic summary data used in the analysis consist of state strings and associated timing data. The state strings provide the basic frequency data on state and state transition occurrences. The timing data provide the basic information on elapsed time within a particular state or between states.

In addition, the source Monitor data are available for additional specific analyses such as average sessions per user or distribution analysis of number of uses per day by individual users. For the eleven-state model, programs of zero-order and first-order analysis are available to the BASIS user.

Zero-Order Analysis. This analysis is concerned with independent frequencies and results in data such as:

- Number of index terms per search
- Number of logic statements per search
- Number of off-line or on-line displays per search
- Average search time
- Average state transition time across all states.

In addition, simple proportions representing the ratio of specific state or function time to overall search time can be computed. These same proportions can be computed for discrete portions of the search sessions as well. For example, all sessions can be divided into thirds and the change in these zero-order statistics over time can be analyzed.

First-Order Analysis. The same state strings used in the zero-order analysis are used in the first-order analysis. The basic products of the first-order analysis are the probability transition matrix and the time transition matrix. The typical products of this analytical technique are:

- Frequency of state-to-state transitions
- Probability of state-to-state transitions
- Elapsed time for each state-to-state transition
- Transition graph of search pattern
- Relative entropy of user/system states.

The frequency and probability transition matrices provide a ready means for statistically comparing portions of the overall sample.

E. System Requirements for Software Development

In the course of establishing system requirements, only one searching capability was identified that could not easily be provided by BASIS retrieval methods. Since the objective of this planning task is limited to conceptual level system design, the additional searching capability was not developed and implemented as a part of the BASIS system. Rather, this capability requirement is discussed in this part of the report so that alternative software development solutions can be discussed. The recommended solution also will be discussed in Section IV, Recommended Implementation Plan.

In the course of satellite conceptual design, the system user needs to determine for a particular launch vehicle the deliverable weight. For this purpose, graphs of deliverable weight as a function of orbital parameters (inclination and altitude) are available. The problem is to design a method for the data base system to "read" values from the graphs. Several alternative methods are to:

- Store digitized curves in the data base and use interpolation methods to determine the appropriate deliverable weight.
- Approximate the curves by nonlinear regression analysis techniques so that a deliverable weight can be computed.
- Devise an interface to a separate orbital simulation computer program that is being used for another task of this contract.

For the purposes of this planning study, it is sufficient that implementation of any one of these methods will satisfy the user requirement of determining the weight deliverable by a launch vehicle.

IV RECOMMENDED IMPLEMENTATION PLAN

It is recommended that the Spacecraft Data Base be implemented in prototype form for testing by the user community. This test phase period should be about three months in duration. After this test period, a final implementation phase should be scheduled for implementation of enhancements recommended by the user group. This final implementation phase should require only about two months for completion.

During the prototype test phase the data base development cost would be about $1,000 (for coding and keying and data base creation of the Satellite Information File). Operational costs would be data storage: $100 per month; computer usage: about $600 per month per user (assuming an average usage of 20 hours of connect time per user per month); data base maintenance: nominal (no updates anticipated); operational support staff: $600 per month; staff for training users: about $500 per user group (a group of one to six persons at one site); travel for training: about $300 per training visit; development of a method for retrieving launch vehicle delivery weight: about $1,000 for staff.

Final implementation phase costs are estimated to be about $4,000 for staff and about $600 for computer cost.

For the operational cost of the final data base system, the costs are estimated to be as for prototype operation; additional data base maintenance costs of no more than $100 per month are estimated (the actual cost would depend upon the update activity).

If it is deemed desirable to operate the data base system at a NASA computer site, the following costs would apply: $75,000 for purchase of the BASIS system (this includes installation on the NASA computer, building the data base on that computer, and software maintenance for one year).

APPENDIX A

TASK STATEMENT OF WORK

APPENDIX A

TASK STATEMENT OF WORK

Background

JPL has assembled a catalog of spacecraft support systems and subsystems covering some 40 separate designs. They are currently developing a catalog of sensors and they plan to develop a Science and Applications requirements catalog in the future. The long range goal is to utilize the data in all of the catalogs to carry out quick systhesis of spacecraft designs to satisfy specific Science and Applications requirements.

Purpose

In this task the spacecraft support systems catalog will be reviewed by Battelle information systems specialists to develop a conceptual design of a retrieval system. Battelle's strong capabilities in the design and implementation of large data base systems together with their space systems knowledge provides a unique capability for transforming the spacecraft support systems catalog into a convenient, computer-based data file for use by system engineers and spacecraft planners.

Scope

This task should review the spacecraft support systems catalog and develop a design for a retrieval and search system for use with the catalog. The study output will be a detailed description of the system, a recommended implementation plan, and cost estimates for implementation and operation.

Time and Costs

It is estimated that this task can be completed in three months from initiation, at a cost of $10,000.

APPENDIX B

SATELLITE INFORMATION FILE CALLUP

APPENDIX B

SATTELITE INFORMATION FILE CALLUP

A. Tabulated inputs

Call Program Name or Project Name

Output - level one detail - all data at first margin

- level two detail - first margin plus first indentation

- level three detail - all data

B. Capability Search at level one - ask for this and printout below -

- type for each below needed in search

Call - 1. Investigation Class/Program

2. Sponsor/Manager
3. Project
4. Contractor
5. Trajectory Class
6. Launch Data
7. Range of Satellite Wieghts
8. Range of Payload Weights
9. Launch Vehicles
10. Stabilization Category
11. Pointing Reference Center
12. Range of Attitude Control Accuracy
13. Range of Attitude Control Knowledge
14. Primary Power Source
15. Range of Maximum Array Power
16. Range of Maximum Battery Power
17. Range of Average Total Power
18. Range of Average Payload Power
19. Range Payload Data Production Rates
20. Range of Telemetry Data Rates

C. Design Search at level one

1. Payload weight
2. Payload power
3. Pointing accuracy
4. Trajectory class

5. Stabilization class
6. Payload Data Production rate
7. Payload Type Class

C. Design Search continued

1. Search for Trajectory Class and Stabilization Class Specified (Do not search further through non-applicable cases.)
2. Payload Weight Search for Payload Class
3. Payload Power Search
4. Altitude Control Search

   Altitude control requirement read in and selects an appropriate decade of capability.

   If .2 control accuracy read in then all S/C with performance between .10001 and 1 are applicable.

   If .007, then between .0010001 and .01.

5. Telemetry Rate Search

   Sensor Data Production Rates read in. This defines the appropriate decade of capability.

   < 30 kb/s
   30.01 kb/s to 300 Mb/s
   300.1 kb/s to 3 Mb/s
   3.001 Mb/s to 30 Mb/s
   30.01 Mb/s to 300 Mb/s
   > 300.1 Mb/s

   All satellites with telemetry reates in that decade or in greater decades are applicable.

D. Capability Search at level two

1. Sensor Type
2. Design Life
3. Stowed Dimensions
4. Launch Range
5. Attitude Angular Rate Control
6. Control Mechanization
7. Battery Capacity

8. Array Articulations
9. Voltage Range
10. In Orbit Propulsion
11. Telemetry Link Frequency(s)
12. RF Power
13. Coding
14. Modulation
15. Command Data Rate
16. Command Link Frequency(s)
17. Tracking Mechanization
18. Tracking Link Frequency(s)
19. Clock Frequency
20. Clock Stability
21. Data Formatting
22. Data Processing Programmability
23. Data Processing Memory
24. Data Storage Capacity
25. Data Storage Playback Rate(s)

E. Design Display

1. List of Satellites by:

Organization	Satellite Name	Satellite Function	Agency	Launch Date(D)

2. Gross Satellite Capability Categories
3. Launch Vehicle Curves

   Scout B&D

   Minuteman III

   Delta/Atlas F/bulks

   Atlas SLV/bulk, Atlas/Agena or Atlas Center

   Litan

   Shuttle

   Geosyncronous

4. Attitude Control

   Pointing accuracy vs Pointing knowledge for spin stabilized and 3 axis stabilized S/C

5. Power - Satellite Average vs Payload Average
6. Array Power Satellite Average vs Max Array Power
7. VHF Downlinks
8. S band Downlinks
9. Data Storage Capability

F. Subsystem Supplier Search - Printout Suppliers with capability in Range Specified

1. Attitude Thruster Jet Size Range
2. Momentum Wheel Size Range
3. Control Logic Programmability
4. Attitude Reference Sensor Accuracy Range
5. Primary Power Range
6. Secondary Power Range
7. In Orbit Propulsion Delta V
8. Telemetry Transmitter Power
9. Telemetry Rate Range
10. Command Rate Range
11. Tracking Frequency Range
12. Clock Stability Range
13. Data Format Type
14. Data Processor Memory Capacity Range
15. Data Storage Capacity

APPENDIX C

INITIAL JPL-DESIGNED DATA COLLECTION FORM

SATELLITE INFORMATION FILE

Program Name	Civilian Meteorology/Defense Meteorology (DMSP)/
Program Sponsor	NOAA-NASA/DoD/
Project Name	TIROS, ITOS, SMS/Block 5D-1/
Project Manager	NESS-GSFC/Air Force ?/
Prime Contractor	RCA, RCA, Philco-Ford/RCA/
Sensor Type	Passive V&IR/Passive μω/Active μω/F&P/X-ray
Sensor Acronyms	
Launch Date[s]	
In-Flight Experience (Yrs.)	
Design Life [Goal, Expendables Sized] (Yrs.)	
Trajectory Class	Polar/Sun Sync/Geostationary/Geosync/Elliptical/
Design Trajectory [Periapsis Altitude, Inclination, Eccentricity, Period] (km, Deg., , Min.)	
Total Satellite Weight at Launch (kg)	
Sensor Payload Weight (kg)	
Weight of Spacecraft Electronics (kg)	TT&C + DH + A/C&PWR Electronics (no payload electronics)
Stowed Dimensions (M Diam. x M Long)	
Launch Vehicle Designation	Delta 2914/Atlas-F/Titan IIID-Agena/Scout D/
First Stage Designation	
First Stage Manufacturer	
Second Stage Designation	
Second Stage Manufacturer	
Third Stage Designation	
Third Stage Manufacturer	
Fourth Stage Designation	
Fourth Stage Manufacturer	
Launch Range	ETR/WTR/San Marcos/
Launch Pad	SLC-3/SLC-5/
Stabilization Category	3-Axis/Spin/Zero Momentum:Yaw Spinner/
Pointing Reference Center	Earth/Sun/Inertial/
Spin Axis Pointing	Along Track/Earth Centered/
Attitude Control Accuracy [All or Pitch, Roll, Yaw] (Deg.)	≤ p0.5, r0.5, y0.7
Attitude Angular Rate Control Accuracy [All or p, r, y] (Deg./Sec.)	≤ p , r , y
Control Mechanization	Gravity/Cold Gas Jets/Hot Gas Jets/Magnetic Torquer/
Jet Gas, Jet Size	Nitrogen/Freon/Hydrazine, .1#/.25#/.5#
Jet Manufacturer	
Wheel Numbers:Locations, Size	3:All Axes, ?
Wheel Manufacturer	
Control Logic Technology [Programmability, Electronics]	Fixed/Multiple Fixed/Programmable/ , IC/LSI/CMOS/
Control Logic Manufacturer	
Attitude Knowledge Accuracy [All or Pitch, Roll, Yaw] (Deg.)	≤ p0.1, r0.1, y0.2
Attitude Reference Sensor[s]	Earth Horizon/Sun/Star Piper/Starmapper/
Attitude Reference Sensor[s] Manufacturer	

SATELLITE INFORMATION FILE (Cont'd)

Primary Power Source	Solar Arrays/RTG:Snap 19/
Primary Power Source Manufacturer	
Secondary Power Source [Number, Capacity, Amp Hrs., Type]	10, 100 ah, N_1C_1/3, 2 ah, AgZn/
Secondary Power Source Manufacturer	
Maximum Primary Power Source Output [Design, EOL] (W)	500, 403
Design β Angle Excursions (Deg.)	60 to 90
Array Articulation [Mounting, Rotations]	Body Mounted/Extendable Panels/Body Fixed/1 Axis/2 Axis
Average Total Power to Satellite (W)	
Average Total Power to Sensor Payload (W)	
Voltage Range (V)	28 ± 4/24 to 36/
In-Orbit Propulsion Functions	Orbit Transfer/Orbit Adjust in Plane/
In-Orbit Propulsion Capability [Fuel, Δv] (f/s)	
In-Orbit Propulsion Manufacturer	
Payload Data Production Rate[s] (b/s)	
Telemetry Data Rate[s] (b/s)	
Telemetry Link Characteristics [Frequency, Bandwidth, RF Power, Coding, Modulation] (GHz, MHz, W)	VHF:.139, .01, 6, Convolution, RZ PCM PSK/S-Band:2.300, .1, 20, Block, PCM FSK/
Telemetry Transmitter Technology	TWT/Solid State/
Telemetry Transmitter Manufacturer	
Command Data Rate[s] (b/s)	
Command Link Characteristics [Frequency, Bandwidth, Coding, Modulation] (GHz, MHz)	
Telemetry & Command Technology	IC/LSI/
Telemetry Manufacturer	
Command Manufacturer	
Tracking Mechanization	Range:Range Rate/Doppler/Laser Retroreflectors
Tracking Manufacturer	
Tracking Link Characteristics [Frequencies, Bandwidth, RF Power] (GHz, MHz, W)	C-Band:4.6, ? , 8/S-Band:2.3, , 20/
Special Telemetry	TDRS/Satellite-to-Satellite
Clock [Frequency, Short Stability, Long Stability] (MHz)	5 MHz, $1_{in}10^{12}$, $1_{in}10^{10}$/
Clock Manufacturer	
Data Formatting [Programmability, Coding]	Hard Wired/Multiple Fixed/Programmable/ , Block/Convolutional/
Data Formatting Manufacturer	
Data Processing [Reprogrammability, Memory Capacity, Discrete Commands, Coded Commands] (b)	Programmable, 10^6, 256, 3/
Data Processing Manufacturer	
Data Storage [Type, Number, Capacity, Record Rates, Playback Rates] (b, b/s, b/s)	Tape/Solid State/Bubble/Film, 0, $10^6/10^8/10^9/10^{10}$, 25k/ , 500k/
Data Storage Manufacturer	

APPENDIX D

REVISED DATA COLLECTION FORM SUBMITTED BY A SATELLITE PRIME CONTRACTOR

SATELLITE INFORMATION FILE

Program Name OSO

Program Sponsor

Project Name OSO - 1

Project Manager

Prime Contractor Hughes Aircraft Co.

Sensor Experience Multichan. UV/Vis Spec., Cosmic X-Ray Spec., Soft X-Ray, Crystal Spec. Polarimeter, High Energy Celestral X-Ray, Mapping X-Ray Heliometer

Sensor Acronyms

Launch Date[s] 1975

In-Flight Experience (Yrs.)

Design Life [Goal, Expendables Sized] (Yrs.) 1 yr. 1 yr.

Trajectory Class 160 km, 30°, 0, 100 min.

Design Trajectory [Periapsis Altitude, Inclination, Eccentricity, Period] (km, Deg., , Min.)

Total Satellite Weight at Launch (kg) 1020 kg

Sensor Payload Weight (kg) 383 kg (130 kg pointed, 252 kg spinning)

Weight of Spacecraft Electronics (kg)

Stowed Dimensions (M Diam. x M Long) 1.52 m dia. x 2.34 m long

Launch Vehicle Designation Delta 2914

First Stage Designation

First Stage Manufacturer

Second Stage Designation

Second Stage Manufacturer

Third Stage Designation

Third Stage Manufacturer

Fourth Stage Designation

Fourth Stage Manufacturer

Launch Range ETR

Launch Pad

Stabilization Category Spin Stabilized

Pointing Reference Center

Spin Axis Pointing Normal to Sun Line

Attitude Control Accuracy [All or Pitch, Roll, Yaw] (Deg.) ± 3 $\widehat{\text{SEC}}$ over 1 Orbit Day

Attitude Angular Rate Control Accuracy [All or p, r, y] (Deg./Sec.) 1 $\widehat{\text{sec}}$ jitter

Control Mechanization

Jet Gas, Jet Size N2 Jets 0.4 lb.

Jet Manufacturer

Wheel Numbers:Locations, Size None

Wheel Manufacturer -

Control Logic Technology [Programmability, Electronics] 3 modes: sun center pointing, offset pointing, raster
- digital closed loop

Control Logic Manufacturer Hughes

Attitude Knowledge Accuracy [All or Pitch, Roll, Yaw] (Deg.) ± 1 $\widehat{\text{SEC}}$ over 1 Orbit Day

Attitude Reference Sensor[s] Sun, Star Sensors

Attitude Reference Sensor[s] Manufacturer Hughes Aircraft

OSO-1 SATELLITE INFORMATION FILE (Cont'd)

Primary Power Source	Solar Array
Primary Power Source Manufacturer	Heliotech and Hughes
Secondary Power Source [Number, Amp Hrs., Type]	(2) 12 AH Nicd Batteries
Secondary Power Source Manufacturer	Battery Cells - G.E.
Maximum Primary Power Source Output [Design, EOL] (W)	464 W BOL, 402 W EOL
Design β Angle Excursions (Deg.)	0
Array Articulation [Mounting, Rotations]	Despin
Average Total Power to Satellite (W)	400W available (EOL)
Average Total Power to Sensor Payload (W)	119 W
Voltage Range (V)	32 ± 1 V

In-Orbit Propulsion Functions	Initial Spin-Up Adjust, Initial Sun Acq., Spin Axis Orientation, Spin Speed Control
In-Orbit Propulsion Capability [Fuel, Δv] (m/s)	N2, 6.4 m/s
In-Orbit Propulsion Manufacturer	Hughes Aircraft

Telemetry

*Ground system compatibility (NASA/GSFC, Aerospace Standards, SCLS, etc.)	NASA/GSFC
*Channel capacity (No. of Channels)	
Channel type (analog, digital, bi-level)	
*Data rate or baseband (Hz)	6.4 kbps RT, 128 kbps stored data
Data source encoding type (PCM, ΔMOD)	8 bit PCM, Manchester coded
Channel encoding type (convolutional, etc.)	
Subcarrier frequency, if used (Hz)	
Subcarrier modulation, technique (FSK, PSK, etc.)	
Data/subcarrier modulation index (radians, etc.)	
*Carrier frequency (MHz)	136.92 MHz-real time; 2212.5 MHz-stored data
Carrier stability (± Hz)	
Carrier modulation technique (PM, FM, etc.)	PM
Subcarrier/carrier modulation index (radians, etc.)	S-Band: 1 radian; VHF: 1.44 radian
Transmitter RF level, tol. (watts, ± watts)	1 W VHF, 1 W S-Band
*Transmitted EIRP, tol. (dBm, ± dB)	
Occupied RF bandwidth (MHz)	
Telemetry subsystem concept (centralized, data bus, etc.)	
Storage capabilities (medium, data bits, programmable, etc.)	Not reprogrammable, tape recorder (1), 8.6×10^7 bits. PB @ 128 kbps
Telemetry subsystem manufacturers	Hughes/EMM/Opetics

Tracking

* Tracking concept for range & range rate (GRARR, DSN/PRN, etc.)	STDN 149.5 MHz up; 136.9 MHz down
Sidetone frequencies, if used (kHz)	
PRN code rate, if used (Cps)	
Uplink carrier modulation (FM, PM, radians, etc.)	
Downlink carrier modulation (PM, radians, etc.)	
* Transponder type (frequency conversion, phase-coherent, demodulate/remodulate)	
Command/telemetry compatibility (timeshared, continuous, etc.)	

OSO-I SATELLITE INFORMATION FILE (Cont'd)

Command

*Command concept (real-time, stored command, etc.)	Stored command, plus real time
*Channel capacity (number of unique addresses)	1365 stored cmds, 128 pulse cmds, 8 serial mag. commands
*Command data rate, format (PCM, etc.)	800 bps; 19 RT commands/sec.; 25 ST cmds/sec "one" 11.5 kHz tone; "zero" 9.1 kHz tone
Command ground encoder compatibility (NASA/GSFC Aerospace Stds, etc.)	
Command word structure (format)	42 bit cmd word,
Subcarrier frequency (Hz)	
Data/subcarrier modulation technique (FSK, PSK)	FSK
Bit sync modulation (AM, integral with data)	AM
Subcarrier/carrier modulation technique (PM, etc.)	AM
Subcarrier/carrier modulation index (radians; etc.)	80 percent
*Carrier frequency, tol. (MHz, ± KHz)	149.5 MHz
Occupied RF bandwidth (KHz)	
Receiver Sensitivity (dBm)	- 60 to - 115 dBm (5 dB NF)
Command group manufacturer	Hughes
Design bit error probability	$\leq 10^{-6}$

APPENDIX E

PROPOSED COMPOSITE DATA COLLECTION FORM

FIELD TITLE	FIELD
IDENT	2
ACCESSION NUMBER	3
FILE NAME	4
SUBFILE NAME	5
PROGRAM	7
PROGRAM NAME	8
PROGRAM SPONSOR	9
PROJECT	10
PROJECT NAME	11
PROJECT MANAGER	12
PRIME CONTRACTOR(S)	14
PRIME CONTRACTOR	15
PRIME CONTRACTOR	16
PRIME CONTRACTOR	17
TRAJECTORY	20
TRAJECTORY CLASS	21
TRAJECTORY ALTITUDE	22
TRAJECTORY INCLINATION	23
TRAJECTORY ECCENTRICITY	24
TRAJECTORY PERIOD	25
SATELLITE	30
WT., SAT. AT LAUNCH	31
IN-FLIGHT EXPERIENCE	32
DESIGN LIFE, GOAL	33
DESIGN LIFE, EXPEND. SIZED	34
WT., SAT. BEGIN OF LIFE	35
WT., SAT. END OF LIFE	36
PAYLOAD	40
PAYLOAD CLASS	41
WT., SENSOR PAYLOAD	42
SENSOR TYPE (EXPERIENCE)	43
SENSOR ACRONYM	44
WT., SENSOR ELECTRONICS	45
STOWED DIMEN., DIAMETER	46
STOWED DIMEN., LENGTH	47
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STOWED DIMEN., HEIGHT	49

LAUNCH	60
LAUNCH VEHICLE CLASS	61
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LAUNCH DATE	63
LAUNCH DATE	64
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ATT. KNOW ACC'Y, REMARKS	141
ATT. KNOW ACC'Y, ALL	142
ATT. KNOW ACC'Y, PITCH	143
ATT. KNOW ACC'Y, ROLL	144
ATT. KNOW ACC'Y, YAW	145
ATT. REFERENCE SENSOR	150
ATT. REF SENS, EARTH	151
ATT. REF SENS, EARTH, MFGR	152
ATT. REF SENS, SUN	154
ATT. REF SENS, SUN, MFGR	155
ATT. REF SENS, STAR	157
ATT. REF SENS, STAR, MFGR	158
ATT. REF SENS, MAGNETOMETER	160
ATT. REF SENS, MAG, MFGR	161
ATT. REF SENS, ELECTROMAG	163
ATT. REF SENS, E MAG., MFGR	164
ATT. REF SENS, ACCELEROMETER	166
ATT. REF SENS, ACCEL, MFGR	167
ATT. REF SENS, BEACON	169
ATT. REF SENS, BEACON, MFGR	170
ATT. REF SENS, OTHER TYPES	172
ATT. REF SENS, OTHER, MFGR	173

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POWER, PRIMARY, DESIGNATION	182
POWER, PRIMARY, MFGR	183
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POWER, SECONDARY, CAPACITY	188
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POWER, SECONDARY, MFGR	190
PSP, MAX OUTPUT DESIGN	192
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PSP, END OF LIFE	194
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APPENDIX F

SATELLITE CATALOG DATA ELEMENT SPECIFICATIONS

LEVEL	CATEGORY CODE	CLASS	INDEX	SELECTIVE RECHL	DESELECTIVE NL	FIELD	FIELD MNEMONIC	FIELD TITLE
0	00.	M				2	IDENT	IDENT
1	00.1	I	I			3	ACC	ACCESSION NUMBER
1	00.2	S	I			4	FILE	FILE NAME
1	00.3	S	I			5	SUBFILE	SUBFILE NAME
0	01.	M				7	PROGRAM	PROGRAM
1	01.1	S	I	C1		8	PROG	PROGRAM NAME
1	01.2	S	I	C1		9	SPONSOR	PROGRAM SPONSOR
0	02.	M				10	PROJECT	PROJECT
1	02.1	S	I	C1		11	PROJ	PROJECT NAME
1	02.2	S	I	C1		12	MANAGER	PROJECT MANAGER
0	03.	M				14	PRIME	PRIME CONTRACTOR(S)
3	03.1.1.1	S	I	C1		15	PRIME1	PRIME CONTRACTOR
3	03.1.1.2	S	I	C1		16	PRIME2	PRIME CONTRACTOR
3	03.1.1.3	S	I	C1		17	PRIME3	PRIME CONTRACTOR
0	04.	M				20	TRAJECTORY	TRAJECTORY
1	04.1	S	I	C1	D1	21	TRAJC	TRAJECTORY CLASS
2	04.1.1	R	N			22	TRAJA	TRAJECTORY ALTITUDE
2	04.1.2	R	N			23	TRAJI	TRAJECTORY INCLINATION
2	04.1.3	R	N			24	TRAJE	TRAJECTORY ECCENTRICITY
2	04.1.4	R	N			25	TRAJP	TRAJECTORY PERIOD
0	05.	M				30	SATELLITE	SATELLITE
1	05.1	R	R	C1		31	WSAL	WT., SAT. AT LAUNCH
2	05.1.1	R	N			32	IFE	IN-FLIGHT EXPERIENCE
2	05.1.2	R	R	C2		33	DLG	DESIGN LIFE, GOAL
2	05.1.3	R	N			34	DLES	DESIGN LIFE, EXPEND. SIZED
1	05.2	R	N			35	WSBOL	WT., SAT. BEGIN OF LIFE
1	05.3	R	N			36	WSEOL	WT., SAT. END OF LIFE
0	06.	M				40	PAYLOAD	PAYLOAD
1	06.1	S	I		D1	41	PC	PAYLOAD CLASS
1	06.2	R	R	C1	D1	42	WSP	WT., SENSOR PAYLOAD
2	06.2.1	S	I	C2		43	ST	SENSOR TYPE (EXPERIENCE)
2	06.2.2	S	N			44	SA	SENSOR ACRONYM MULTIPLE SENSORS POSSIBLE
2	06.2.3	R	N			45	WSE	WT., SENSOR ELECTRONICS
2	06.2.4	R	R	C2		46	SDD	STOWED DIMEN., DIAMETER
2	06.2.5	R	R	C2		47	SDL	STOWED DIMEN., LENGTH
0	07.	M				60	LAUNCH	LAUNCH
1	07.1	S	I	C1		61	LVC	LAUNCH VEHICLE CLASS
2	07.1.1	I	R	C1		62	LD1	LAUNCH DATE
2	07.1.2	I	R	C1		63	LD2	LAUNCH DATE
2	07.1.3	I	R	C1		64	LD3	LAUNCH DATE
2	07.2	S	I	C1		70	LV	LAUNCH VEHICLE DESIGNATION
2	07.2.1	S	N			71	S1D	STAGE 1 DESIGNATION
3	07.2.1.1	S	N			72	S1M	STAGE 1 MANUFACTURER
2	07.2.2	S	N			73	S2D	STAGE 2 DESIGNATION
3	07.2.2.1	S	N			74	S2M	STAGE 2 MANUFACTURER
2	07.2.3	S	N			75	S3D	STAGE 3 DESIGNATION
3	07.2.3.1	S	N			76	S3M	STAGE 3 MANUFACTURER
2	07.2.4	S	N			77	S4D	STAGE 4 DESIGNATION
3	07.2.4.1	S	N			78	S4M	STAGE 4 MANUFACTURER
2	07.3	S	I	C2		79	LR	LAUNCH RANGE
2	07.3.1	S	N			80	LP	LAUNCH PAD

0	08.	M				90	STABILIZE	STABILIZATION
1	08.1	S	I	C1	D1	91	SC	STABILIZATION CATEGORY
1	08.2	S	I	C1		92	SPRC	POINTING REF. CENTER
2	08.2.1	S	N			93	SADP	SPIN AXIS POINTING DIR.
0	09.	M				100	ATTITUDE	ATTITUDE CONTROL
1	09.0	M				101	CONTROL	ATTITUDE CONTROL
1	09.1	S	N			102	ACAM	ATT. CONTROL ACC'Y, REMARKS
1	09.2	R	R	C1	D1	103	ACAA	ATT. CONTROL ACC'Y, ALL
1	09.3	R	R	C1	D1	104	ACAP	ATT. CONTROL ACC'Y, PITCH
1	09.4	R	R	C1	D1	105	ACAR	ATT. CONTROL ACC'Y, ROLL
1	09.5	R	R	C1	D1	106	ACAY	ATT. CONTROL ACC'Y, YAW
1	09.6	M				110	ANGRATE	ANG RATE CONTROL ACC'Y
2	09.6.1	S	N			111	ARCAM	ANG RATE CONT'L ACC, REMARKS
2	09.6.2	R	R	C2		112	ARCAA	ANG RATE CONTROL ACC, ALL
2	09.6.3	R	R	C2		113	ARCAP	ANG RATE CONTROL ACC, PITCH
2	09.6.4	R	R	C2		114	ARCAR	ANG RATE CONTROL ACC, ROLL
2	09.6.5	R	R	C2		115	ARCAY	ANG RATE CONTROL ACC, YAW
1	09.7	M				120	MECHANISM	CONTROL MECHANISM
2	09.7.1	S	I	C2		121	ACM	CONTROL MECHANISM
2	09.7.2	S	N			122	ACJG	CONTROL MECH, JET GAS
2	09.7.3	R	N			123	ACJS	CONTROL MECH, JET SIZE
3	09.7.3.1	S	N			124	ACJM	CONTROL MECH, JET MFGR
2	09.7.4	I	N			125	ACWN	CONTROL MECH, WHEEL NUMBERS
2	09.7.5	S	N			126	ACWL	CONTROL MECH, WHEEL LOCATION
2	09.7.6	R	N			127	ACWS	CONTROL MECH, WHEEL SIZE
3	09.7.6.1	S	N			128	ACWM	CONTROL MECH, WHEEL MFGR
1	09.8	M				130	LOGIC	ATT. CONTROL LOGIC
2	09.8.1	S	N			131	ACLT	ATT. CONT'L LOGIC TECHNOLOGY
3	09.8.1.1	S	N			132	ACLM	ATT. CONTROL LOGIC, MFGR
0	10.	M				140	KNOWLEDGE	ATTITUDE KNOWLEDGE
1	10.1	S	N			141	AKAM	ATT. KNOW ACC'Y, REMARKS
1	10.2	R	R	C1		142	AKAA	ATT. KNOW ACC'Y, ALL
1	10.3	R	R	C1		143	AKAP	ATT. KNOW ACC'Y, PITCH
1	10.4	R	R	C1		144	AKAR	ATT. KNOW ACC'Y, ROLL
1	10.5	R	R	C1		145	AKAY	ATT. KNOW ACC'Y, YAW
1	10.6	M				150	ARSENSOR	ATT. REFERENCE SENSOR
2	10.6.1	S	N			151	ARSE	ATT. REF SENS, EARTH
3	10.6.1.1	S	N			152	ARSEM	ATT. REF SENS, EARTH, MFGR
2	10.6.2	S	N			154	ARSUN	ATT. REF SENS, SUN
3	10.6.2.1	S	N			155	ARSUNM	ATT. REF SENS, SUN, MFGR
2	10.6.3	S	N			157	ARSTAR	ATT. REF SENS, STAR
3	10.6.3.1	S	N			158	ARSTARM	ATT. REF SENS, STAR, MFGR
2	10.6.4	S	N			160	ARSMAG	ATT. REF SENS, MAGNETOMETER
3	10.6.4.1	S	N			161	ARSMAGM	ATT. REF SENS, MAG, MFGR
2	10.6.5	S	N			163	ARSEMAG	ATT. REF SENS, ELECTROMAG
3	10.6.5.1	S	N			164	ARSEMAGM	ATT. REF SENS, E MAG., MFGR
2	10.6.6	S	N			166	ARSACCL	ATT. REF SENS, ACCELEROMETER
3	10.6.6.1	S	N			167	ARSACCLM	ATT. REF SENS, ACCEL, MFGR
2	10.6.7	S	N			169	ARSMB	ATT. REF SENS, BEACON
3	10.6.7.1	S	N			170	ARSMBM	ATT. REF SENS, BEACON, MFGR
2	10.6.8	S	N			172	ARSOTHR	ATT. REF SENS, OTHER TYPES
3	10.6.8.1	S	N			173	ARSOTHRM	ATT. REF SENS, OTHER, MFGR

Ø	11.	M			180	POWER	POWER SOURCE
1	11.1	S	I	C1	181	PSPC	POWER, PRIMARY, CLASS
2	11.1.1	S	N		182	PSPD	POWER, PRIMARY, DESIGNATION
3	11.1.1.1	S	N		183	PSPM	POWER, PRIMARY, MFGR
1	11.2	S	N		185	PSSC	POWER, SECONDARY, CLASS
2	11.2.1	I	N		186	PSSN	POWER, SECONDARY, NUMBER
2	11.2.2	R	R	C1	187	PSSMP	POWER, SECONDARY, MAX POWER
2	11.2.3	R	R	C2	188	PSSCAP	POWER, SECONDARY, CAPACITY
2	11.2.4	S	N		189	PSST	POWER, SECONDARY, TYPE
3	11.2.4.1	S	N		190	PSSM	POWER, SECONDARY, MFGR
1	11.3	R	R	C1	192	PSPMOD	PSP, MAX OUTPUT DESIGN
1	11.4	R	R	C1	193	PSPBOL	PSP, BEGIN OF LIFE
1	11.5	R	R	C1	194	PSPEOL	PSP, END OF LIFE
1	11.6	R	R	C1	195	PSPMAP	PSP, MAX ARRAY POWER
2	11.6.1	R	N		196	PSPBAE	PSP, BETA ANG EXCURSIONS
2	11.6.2	S	I	C2	197	PSPAAM	PSP, ARRAY ATRICUL, MOUNTING
2	11.6.3	S	I	C2	198	PSPAAR	PSP, ARRAY ARTICUL, ROTATION
1	11.7	R	R	C1	199	PAS	POWER, AVG TO SATELLITE
1	11.8	R	R	C1 D1	201	PAP	POWER, AVG TO PAYLOAD SENSOR
1	11.9	M			202	VOLTAGE	VOLTAGE
2	11.9.1	R	R	C2	203	VA	VOLTAGE, AVERAGE
2	11.9.2	R	R	C2	204	VMIN	VOLTAGE, MINIMUM
2	11.9.3	R	R	C2	205	VMAX	VOLTAGE, MAXIMUM
2	11.9.4	S	N		206	VR	VOLTAGE, RANGE
Ø	12.	M			210	PROPULSION	PROPULSION, IN-ORBIT FUNCTIONS
1	12.1	S	I		211	PIF1	PROP, IN-ORBIT FUNCTIONS
2	12.1.1	S	N		212	PICF1	PROP, IN-ORBIT CAP, FUEL
2	12.1.2	R	R	C2	213	PICV1	PROP, IN-ORBIT CAP, DELTA V
3	12.1.2.1	S	N		214	PIM1	PROP, IN-ORBIT, MFGR
1	12.2	S	I		216	PIF2	PROP, IN-ORBIT FUNCTIONS
2	12.2.1	S	N		217	PICF2	PROP, IN-ORBIT CAP, FUEL
2	12.2.2	R	R	C2	218	PICV2	PROP, IN-ORBIT CAP, DELTA V
3	12.2.2.1	S	N		219	PIM2	PROP, IN-ORBIT, MFGR
1	12.3	S	I		221	PIF3	PROP, IN-ORBIT FUNCTIONS
2	12.3.1	S	N		222	PICF3	PROP, IN-ORBIT CAP, FUEL
2	12.3.2	R	R	C2	223	PICV3	PROP, IN-ORBIT CAP, DELTA V
3	12.3.2.1	S	N		224	PIM3	PROP, IN-ORBIT, MFGR
Ø	13.	M			230	DATARATE	DATA RATE, PAYLOAD PROD.
1	13.1	R	R	C1 D1	231	DRP	DATA RATE, PAYLOAD
Ø	14.	M			240	TELEMETRY	TELEMETRY
1	14.1	M			241	TIDENT	TELEMETRY IDENTIFICATION
2	14.1.1	S	N		242	TGSC	TELE GROUND SYS COMPATABILITY
2	14.1.2	S	N		243	TSC	TELE SYS CONCEPT
3	14.1.2.1	S	N		244	TSM	TELE SYS MFGR
1	14.2	M			246	TSSTORAGE	TELE SYS STORAGE
2	14.2.1	S	N		247	TSST	TELE SYS STORAGE TYPE
2	14.2.2	I	N		248	TSSQ	TELE SYS STORAGE QUANTITY
2	14.2.3	R	N		249	TSSC	TELE SYS STORAGE CAPACITY
2	14.2.4	R	N		250	TSSRR	TELE SYS STORAGE RECORD RATE
2	14.2.5	R	N		251	TSSPR	TELE SYS STORAGE PLAYBACK RATE
2	14.2.6	S	N		252	TSSP	TELE SYS STORAGE PROGRAMBLTY
3	14.2.6.1	S	N		253	TSSM	TELE SYS STORAGE MFGR
1	14.3	M			255	TDATARATE	TELE DATA RATE

2	14.3.1	R	R C1	256	TDDR	TELE DIGITAL DATA RATE
2	14.3.2	R	R C1	257	TABB	TELE ANALOG BASEBAND
1	14.4	M		260	TCARRIER	TELE CARRIER
2	14.4.1	R	R C2	261	TCF	TELE CARRIER FREQUENCY
2	14.4.2	R	R C2	262	TCFMIN	TELE CARRIER FREQ RANGE MIN
2	14.4.3	R	R C2	263	TCFMAX	TELE CARRIER FREQ RANGE MAX
2	14.4.4	R	N	264	TCS	TELE CARRIER STABILITY
2	14.4.5	R	N	265	TCB	TELE CARRIER BANDWIDTH
2	14.4.6	S	N	266	TCMT	TELE CARRIER MODULATION TECH
1	14.5	M		267	TCODING	TELE DATA CODING TECH
2	14.5.1	S	I C2	268	TDCT1	TELE DATA CODING TECH (1)
2	14.5.2	S	I C2	269	TDCT2	TELE DATA CODING TECH (2)
2	14.5.3	S	I C2	270	TDCT3	TELE DATA CODING TECH (3)
2	14.5.4	S	I C2	271	TDCT4	TELE DATA CODING TECH (4)
1	14.6	M		275	TPOWER	TELE TRANSMITTER RF POWER
2	14.6.1	R	R C2	276	TTRFL	TELE TRANSMITTER RF LEVEL
2	14.6.2	R	R C2	277	TTRFLT	TELE TRANSMITTER RF TOLERANCE
2	14.6.3	R	R C2	278	TTEIRP	TELE TRANSMITTED EIRP
2	14.6.4	R	R C2	279	TTEIRPT	TELE TRANSMITTED EIRP TOL.
1	14.7	M		290	TSCARRIER	TELE SUBCARRIER
2	14.7.1	R	N	291	TSCF1	TELE SUBCARRIER FREQ (1)
2	14.7.2	R	N	292	TSCF2	TELE SUBCARRIER FREQ (2)
2	14.7.3	R	N	293	TSCF3	TELE SUBCARRIER FREQ (3)
2	14.7.4	R	N	294	TSCF4	TELE SUBCARRIER FREQ (4)
2	14.7.5	S	N	295	TSCM1	TELE SUBCARRIER MODUL (1)
2	14.7.6	S	N	296	TSCM2	TELE SUBCARRIER MODUL (2)
2	14.7.7	S	N	297	TSCM3	TELE SUBCARRIER MODUL (3)
2	14.7.8	S	N	298	TSCM4	TELE SUBCARRIER MODUL (4)
2	14.7.9	R	N	299	TSCMI	TELE SUB/CARRIER INDEX
1	14.8	M		300	TCHANNEL	TELE CHANNEL
2	14.8.1	S	N	301	TCT1	TELE CHANNEL TYPE (1)
2	14.8.2	S	N	302	TCT2	TELE CHANNEL TYPE (2)
2	14.8.3	S	N	303	TCT3	TELE CHANNEL TYPE (3)
2	14.8.4	S	N	304	TCT4	TELE CHANNEL TYPE (4)
2	14.8.5	R	N	305	TCC1	TELE CHANNEL CAPACITY (1)
2	14.8.6	R	N	306	TCC2	TELE CHANNEL CAPACITY (2)
2	14.8.7	R	N	307	TCC3	TELE CHANNEL CAPACITY (3)
2	14.8.8	R	N	308	TCC4	TELE CHANNEL CAPACITY (4)
2	14.8.9	R	N	309	TCCT	TELE CHANNEL CODING TECH
0	15.	M		310	COMMAND	COMMAND
1	15.1	M		311	CIDENT	COMMAND IDENTIFICATION
2	15.1.1	S	N	312	CGEC	COMMAND GROUND ENCODER COMPAT
2	15.1.2	S	N	313	CSC	COMMAND SYS CONCEPT
3	15.1.2.1	S	N	314	CSM	COMMAND SYS MFGR
1	15.3	M		317	CDATARATE	COMMAND DATA RATE
2	15.3.1	R	R C2	318	CDDR	COMMAND DIGITAL DATA RATE
2	15.3.2	R	R C2	319	CABB	COMMAND ANALOG BASEBAND
1	15.4	M		320	CCARRIER	COMMAND CARRIER
2	15.4.1	R	R C2	321	CCF	COMMAND CARRIER FREQ
2	15.4.2	R	R C2	322	CCFMIN	COMMAND CARRIER FREQ RNG MIN
2	15.4.3	R	R C2	323	CCFMAX	COMMAND CARRIER FREQ RNG MAX
2	15.4.4	R	N	324	CCT	COMMAND CARRIER TOLERANCE
2	15.4.5	R	N	325	CCB	COMMAND CARRIER BANDWIDTH
2	15.4.6	S	N	326	CCBSM	COMMAND CARRIER BIT SYNC MOD.
1	15.5	M		327	CCODING	COMMAND CODING
2	15.5.1	S	N	328	CCDF	COMMAND DATA FORMAT
2	15.5.2	S	N	329	CCWS	COMMAND WORD STRUCTURE
2	15.5.3	S	N	330	CDSM	COMMAND DATA/SUBCARRIER MOD.
1	15.7	M		340	CSCARRIER	COMMAND SUBCARRIER
2	15.7.1	R	N	341	CSCF	COMMAND SUBCARRIER FREQ
2	15.7.5	S	N	345	CSCM	COMMAND SUBCARRIER MOD.
2	15.7.9	R	N	349	CSCMI	COMMAND SUB/CARRIER MOD INDEX

1	15.8	M		350	CCHANNEL	COMMAND CHANNEL
2	15.8.1	S	N	351	CCT	COMMAND CHANNEL TYPE
2	15.8.5	R	N	355	CCC	COMMAND CHANNEL CAPACITY
2	15.8.9	S	N	359	CCCT	COMMAND CHANNEL CODING TECH
1	15.9	M		360	CRECEIVER	COMMAND RECEIVER
2	15.9.1	S	N	361	CRS	COMMAND RECEIVER SENSITIVITY
2	15.9.2	R	N	362	CRSMIN	COMMAND RECEIVER SENS MIN
2	15.9.3	R	N	363	CRSMAX	COMMAND RECEIVER SENS MAX
2	15.9.6	R	N	366	CDBEP	COMMAND DESIGN BIT ERROR PROB
0	16.	M		370	TRACKING	TRACKING
1	16.1	M		371	TRIDENT	TRACKING IDENTIFICATION
2	16.1.1	S	I C2	372	TRGSC	TRACKING GROUND SYS COMPAT
2	16.1.2	S	I C2	373	TRC	TRACKING CONCEPT
2	16.1.3	S	I C2	374	TRCTC	TRACKING COMMAND/TELE COMPAT
3	16.1.3.1	S	N	375	TRM	TRACKING MFGR
1	16.2	M		376	TRUL	TRACKING UPLINK
2	16.2.1	S	N	377	TRULR	TRACKING UPLINK, REMARKS
2	16.2.2	R	R C2	378	TRULF	TRACKING UPLINK FREQUENCY
2	16.2.3	S	N	379	TRULMT	TRACKING UPLINK MOD TECH
2	16.2.4	R	N	380	TRULMI	TRACKING UPLINK MOD INDEX
2	16.2.5	R	N	381	TRULBW	TRACKING UPLINK BANDWIDTH
2	16.2.6	R	N	382	TRULRFL	TRACKING UPLINK RF LEVEL
1	16.3	M		383	TRDL	TRACKING DOWNLINK
2	16.3.1	S	N	384	TRDLR	TRACKING DOWNLINK, REMARKS
2	16.3.2	R	R C2	385	TRDLF	TRACKING DOWNLINK FREQUENCY
2	16.3.3	S	N	386	TRDLMT	TRACKING DOWNLINK MOD TECH
2	16.3.4	R	N	387	TRDLMI	TRACKING DOWNLINK MOD INDEX
2	16.3.5	R	N	388	TRDLBW	TRACKING DOWNLINK BANDWIDTH
2	16.3.6	R	N	389	TRDLRFL	TRACKING DOWNLINK RF LEVEL
1	16.4	M		390	TRST	TRACKING SIDETONE
2	16.4.1	S	N	391	TRSTR	TRACKING SIDETONE, REMARKS
2	16.4.2	S	N	392	TRSTFR	TRACKING SIDETONE FREQ RANGE
2	16.4.3	R	N	393	TRSTF	TRACKING SIDETONE FREQUENCY
1	16.5	M		394	TRT	TRACKING TRANSPONDER
2	16.5.1	S	N	395	TRTT	TRACKING TRANSPONDER TYPE
1	16.6	M		397	TRPRN	TRACKING PRN
2	16.6.1	R	N	398	TRPRNCR	TRACKING PRN CODE RATE
0	17.	M		400	CLOCK	CLOCK
1	17.1	S	N	401	CR	CLOCK, REMARKS
2	17.1.1	R	R C2	402	CF	CLOCK FREQUENCY
2	17.1.7	R	R C2	408	CSS	CLOCK SHORT STABILITY
2	17.1.8	R	R C2	409	CLS	CLOCK LONG STABILITY
3	17.1.8.1	S	N	410	CM	CLOCK MFGR

APPENDIX G

INDEX TERMS FOR THE PROTOTYPE SATELLITE CATALOG DATA BASE

1	ACAA:0.0002/0.0090
5	ACAA:0.010/1.000
1	ACA:0.0002/0.0090
5	ACA:0.010/1.000
2	ACC:101
1	ACC:103
1	ACC:104
1	ACC:105
1	ACC:106
5	ACM:GAS JET
1	AKAA:0.0002/0.0090
3	AKAA:0.010/1.000
2	AKAP:0.010/1.000
2	AKAY:0.010/1.000
1	AKA:0.0002/0.0090
5	AKA:0.010/1.000
2	ARCAY:0.000000000/0.000019999
2	ARCA:0.000000000/0.000019999
1	CCFMAX:100.0/999999.0
1	CCFMIN:100.0/999999.0
2	CCF:1.010/99.999
2	CCF:100.0/999999.0
5	CDDR:1.010/99.999
2	CDDR:100.0/999999.0
6	DLG:1/1000
6	FILE:SATELLITE CATALOG
5	LD1:1001/10000
5	LD:1001/10000
6	LR:ETR
1	LV:ATLAS CENTAUR
5	LV:DELTA 2914
6	PAP:1/1000
6	PAS:1/1000
1	PC:ASTRONOMY
5	PC:COMMUNICATIONS
1	PC:INSTRUMENTATION
6	PICV1:1/1000
5	PICV2:1/1000
1	PICV2:1001/10000
1	PICV3:1/1000
4	PICV3:1001/10000
6	PICV:1/1000
5	PICV:1001/10000
1	PIF1:ATTITUDE ADJUST
1	PIF1:ATTITUDE CONTROL
1	PIF1:INITIAL SPIN-UP ADJUSTMENT
1	PIF1:INITIAL SUN ACQUITION
1	PIF1:ORBIT ADJUST
2	PIF1:ORBIT ADJUSTMENT
1	PIF2:APOGEE BOOST
1	PIF2:ATTITUDE ADJUST
2	PIF2:ATTITUDE ADJUSTMENT
1	PIF2:ORBIT CONTROL

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1   PIF2:SPIN AXIS ORIENTATION
4   PIF3:APOGEE BOOST
1   PIF3:SPIN SPEED CONTROL
5   PIF:APOGEE BOOST
2   PIF:ATTITUDE ADJUST
2   PIF:ATTITUDE ADJUSTMENT
1   PIF:ATTITUDE CONTROL
1   PIF:INITIAL SPIN-UP ADJUSTMENT
1   PIF:INITIAL SUN ACQUITION
1   PIF:ORBIT ADJUST
2   PIF:ORBIT ADJUSTMENT
1   PIF:ORBIT CONTRCL
1   PIF:SPIN AXIS ORIENTATION
1   PIF:SPIN SPEED CONTROL
4   PRIME1:HUGHES AIRCRAFT CO.
2   PRIME1:HUGHES AIRCRAFT CO,
4   PRIME:HUGHES AIRCRAFT CO.
2   PRIME:HUGHES AIRCRAFT CO,
1   PROG:OSO (ORBITING SOLAR OBSERVATORY)
2   PROJ:ANIK 2
1   PROJ:COMSAT
1   PROJ:GMS
1   PROJ:INTELSAT IV
1   PROJ:JAPANESE GEOSTATIONARY METEOROLOGICAL SATEL
1   PROJ:MARISAT
2   PROJ:WESTAR
1   PSPAAM:DESPIN
4   PSPAAM:SPINNING CYLINDER
1   PSPAAM:SPUN
5   PSPBOL:1/1000
6   PSPC:SOLAR ARRAY
6   PSPEOL:1/1000
1   PSPMAP:1/1000
5   PSSCAP:1/1000
5   SC:SPIN
1   SC:SPIN (AT 100 OV RPM)
6   SDD:1/1000
6   SDL:1/1000
1   SPONSOR:MARITIME
1   SPONSOR:U.S. NAVY
1   SPRC:SUN
1   ST:EARTH
1   ST:HELMTER
1   ST:HIGH ENERGY CELESTIAL X-RAY
1   ST:MAPPING X-RAY
1   ST:NO SCIENCE PAYLOAD
1   ST:SOLAR ACTIVITY MEASUREMENT
1   ST:SPEC. POLARIMETER
1   ST:SUN
1   ST:UHF, C-BAND, L-BAND TRANSPONDERS
1   ST:VIS/IR SPIN SCAN RADIOMETER
6   SUBFIL:SATELLITE
2   TCFMAX:100.0/999999.0
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2	TCFMIN:100.0/999999.0
2	TCF:1.010/99.999
4	TCF:100.0/999999.0
2	TDCT1:PAM
1	TDCT1:PCM (MANCHESTER, 8 BIT)
1	TDCT1:PCM NRZ-M
1	TDCT1:PCM, 8 BIT
1	TDCT1:PCM, 8 BIT (MANCHESTER CODED)
1	TDCT1:8 BIT
1	TDCT2:RT - SUN EARTH MASTER INDEX
2	TDCT2:SUBCARRIER MODULATED BY BI-LEVEL DATA
1	TDCT3:RT - SUN EARTH
2	TDCT:PAM
1	TDCT:PCM (MANCHESTER, 8 BIT)
1	TDCT:PCM NRZ-M
1	TDCT:PCM, 8 BIT
1	TDCT:PCM, 8 BIT (MANCHESTER CODED)
1	TDCT:RT - SUN EARTH
1	TDCT:RT - SUN EARTH MASTER INDEX
2	TDCT:SUBCARRIER MODULATED BY BI-LEVEL DATA
1	TDCT:8 BIT
2	TDDR:1/1000
1	TDDR:1001/10000
5	TRAJC:GEOSYNCHRONOUS ORBIT
1	TRAJC:LOW EARTH ORBIT
1	TTEIRP:0.000000000/0.00001999
3	TTEIRP:1.010/99.999
4	TTRFL:1/1000
6	VA:1/1000
6	VMAX:1/1000
6	VMIN:1/1000
4	WSAL:1/1000
2	WSAL:1001/10000
6	WSP:1/1000

APPENDIX H

PROFILES FOR TABULAR DISPLAY OF SATELLITE CATALOG INFORMATION

```
    PROFILE SHOW

  **** AVAILABLE PROFILES ****

  ******   USERS   ******
ID        .NAME.
A1    TEST

  ****** DATA BASE ******
ID        .NAME.
B1    PROGRAM AND PROJECT
B2    TRAJECTORY PARAMETERS
B3    SATELLITE LIFE AND WEIGHT
B4    PAYLOAD
B5    LAUNCH
B6    LAUNCH VEHICLE DESIGNATION
B7    LAUNCH VEHICLE MANUFACTURER
B8    STABILIZATION
B9    ATTITUDE CONTROL
B10   CONTROL MECHANISM JETS
B11   ATTITUDE CONTROL LOGIC
B12   ATTITUDE KNOWLEDGE
B13   ATTITUDE REFERENCE SENSOR
B14   ATTITUDE REFERENCE SENSOR MFGR
B15   PRIMARY POWER SOURCE
B16   PRIMARY POWER
B17   SECONDARY POWER
B18   ALL TABLES
DO YOU WISH TO EXECUTE ANY OF THE PROFILES?
   / NO
ENTER YOUR REQUEST
```

PROFILE EXECUTE PROGRAM AND PROJECT

PROGRAM AND PROJECT PAGE 1

PROGRAM NAME	PROGRAM SPONSOR	PROJECT NAME	PROJECT MANAGER	PRIME CONTRACTOR
- - - - - - -	- - - - - - - -	ANIK 2 WESTAR	- - - - -	HUGHES AIRCRAFT CO.
- - - - - - -	- - - - - - - -	WESTAR ANIK 2	- - - - -	HUGHES AIRCRAFT CO.
- - - - - - -	U.S. NAVY MARITIME	MARISAT	- - - - -	HUGHES AIRCRAFT CO.
- - - - - - -	- - - - - - - -	GMS JAPANESE GEOSTATIONARY METEOROLOGICAL SATELLITE	- - - - -	HUGHES AIRCRAFT CO,
- - - - - - -	- - - - - - - -	OSO 1 ORBITING SOLAR OBSERVATORY	- - - - -	HUGHES AIRCRAFT CO.
- - - - - - -	- - - - - - - -	INTELSAT IV COMSAT	- - - - -	HUGHES AIRCRAFT CO,

PROFILE EXECUTE TRAJECTORY PARAMETERS

TRAJECTORY PARAMETERS PAGE 1

TRAJECTORY CLASS	TRAJECTORY ALTITUDE	TRAJECTORY INCLINATION	TRAJECTORY ECCENTRICITY	TRAJECTORY PERIOD
GEOSYNCHRONOUS ORBIT	35,789.00	0	0	24
GEOSYNCHRONOUS ORBIT	35,789.00	0	0	24
GEOSYNCHRONOUS ORBIT	35,000.00	0	0	24
GEOSYNCHRONOUS ORBIT	35,000.00	0	0	24
LOW EARTH ORBIT	130.00	30	0	1
GEOSYNCHRONOUS ORBIT	35,000.00	0	0	24

PROFILE EXECUTE SATELLITE LIFE AND WEIGHT

SATELLITE LIFE AND WEIGHT PAGE 1

DESIGN LIFE GOAL	DESIGN LIFE EXPEND. SIZED	IN-FLIGHT EXPERIENCE	SATELLITE WEIGHT AT LAUNCH	SATELLITE WEIGHT BEGIN OF LIFE	SATELLITE WEIGHT END OF LIFE
7 YR	7 YR	5 YEARS (AGGRAGATE, ALL SATS)	562 KG (EXCLUDING LV ADAPTER)	296 KG	240 KG
7 YR	7 YR	5 YEARS (AGGRAGATE, ALL SATS)	562 KG (EXCLUDING LV ADAPTER)	296 KG	240 KG
5 YR	5 YR	- - - - - - -	318 KG	- - - - - - - - - -	
5 YR	3 YR	NONE	670 KG (EXCLUDING ADAPTER)	- - - - -	288 KG
1 YR	1 YR	- - - - - - -	1020 KG	- - - - - - - - - -	
7 YR	- - - - - -	0.25 YR	1480 KG	790 KG	667 KG

PROFILE EXECUTE PAYLOAD

PAYLOAD

PAGE 1

PAYLOAD CLASS	WEIGHT OF SENSOR PAYLOAD	SENSOR TYPE EXPERIENCE	SENSOR ACRONYM	STOWED DIMEN. DIA.	STOWED DIMEN. LENGTH	STOWED DIMEN. WIDTH	STOWED DIMEN. HEIGHT
COMMUNICATIONS	55 KG (TRANSPONDER AND ANTENNA)	- - - - -	- - - - -	185 CM	336 CM	- - -	- - -
COMMUNICATIONS	55 KG (TRANSPONDER AND ANTENNA)	- - - - -	- - - - -	185 CM	336 CM	- - -	- - -
COMMUNICATIONS	68 KG	NO SCIENCE PAYLOAD UHF, C-BAND, L-BAND TRANSPONDERS	- - - - -	216 CM	381 CM	- - -	- - -
COMMUNICATIONS INSTRUMENTATION	109 KG	VIS/IR SPIN SCAN RADIOMETER SOLAR ACTIVITY MEASUREMENT	VISSR SEM	216 CM	363 CM	- - -	- - -
ASTRONOMY	383 KG 130 KG (POINTED) 252 KG (SPINNING)	SPEC. POLARIMETER HIGH ENERGY CELESTIAL X-RAY MAPPING X-RAY HELIMETER	- - - - -	152 CM	234 CM	- - -	- - -
COMMUNICATIONS	167 KG	EARTH SUN	- - - - -	240 CM	717 CM	- - -	- - -

PROFILE EXECUTE LAUNCH

LAUNCH PAGE 1

LAUNCH VEHICLE CLASS	LAUNCH DATE	LAUNCH RANGE	LAUNCH PAD
DELTA 2914	1972 1974	ETR	17B
DELTA 2914	1972 1974	ETR	17B
DELTA 2914	1975	ETR	- - - - - -
DELTA 2914	- - - - - -	ETR	- - - - - -
DELTA 2914	1975	ETR	- - - - - -
ATLAS CENTAUR	1975 1976	ETR	- - - - - -

PROFILE EXECUTE LAUNCH VEHICLE DESIGNATION

LAUNCH VEHICLE DESIGNATION PAGE 1

LAUNCH VEHICLE DESIGNATION	STAGE 1 DESIGNATION	STAGE 2 DESIGNATION	STAGE 3 DESIGNATION	STAGE 4 DESIGNATION
DELTA 2914	- - - - - -	- - - - - -	- - - - - -	- - - - - -
DELTA 2914	- - - - - -	- - - - - -	- - - - - -	- - - - - -
DELTA 2914	- - - - - -	- - - - - -	- - - - - -	- - - - - -
DELTA 2914	- - - - - -	- - - - - -	- - - - - -	- - - - - -
DELTA 2914	- - - - - -	- - - - - -	- - - - - -	- - - - - -
ATLAS CENTAUR	- - - - - -	- - - - - -	- - - - - -	- - - - - -

PROFILE EXECUTE LAUNCH VEHICLE MANUFACTURER

LAUNCH VEHICLE MANUFACTURE$_R$ PAGE 1

LAUNCH VEHICLE DESIGNATION	STAGE 1 MANUFACTUPER	STAGE 2 MANUFACTURE	STAGE 3 MANUFACTURER	STAGE 4 MANUFACUTER
DELTA 2914	- - - - - -	- - - - - -	- - - - - -	- - - - - -
DELTA 2914	- - - - - -	- - - - - -	- - - - - -	- - - - - -
DELTA 2914	- - - - - -	- - - - - -	- - - - - -	- - - - - -
DELTA 2914	- - - - - -	- - - - - -	- - - - - -	- - - - - -
DELTA 2914	- - - - - -	- - - - - -	- - - - - -	- - - - - -
ATLAS CENTAUR	- - - - - -	- - - - - -	- - - - - -	- - - - - -

PROFILE EXECUTE STABILIZATION

STABILIZATION PAGE 1

STABILIZATION CATEGORY	POINTING REFERENCE CENTER	SPIN AXIS POINTING CENTER
SPIN	- - - - - - - - - -	ALONG ORBIT NORMAL
SPIN	- - - - - - - - - -	ALONG ORBIT NORMAL
SPIN	- - - - - - - - - -	ALONG ORBIT NORMAL
SPIN (AT 100 OV RPM)	- - - - - - - - - -	ALONG ORBIT NORMAL
SPIN	SUN	NORMAL TO SUN LINE
SPIN	- - - - - - - - - -	ALONG ORBIT NORMAL

PROFILE EXECUTE ATTITUDE CONTROL

ATTITUDE CONTROL PAGE 1

ATTITUDE CONTROL ACCURACY, REMARKS	ATTITUDE CONTROL ACCURACY, ALL	ATTITUDE CONTROL ACCURACY, PITCH	ATTITUDE CONTROL ACCURACY, ROLL	ATTITUDE CONTROL ACCURACY, YAW
0.17 DEG (N-S) 0.	0.17 DEG 0.09 DEG	- - - - - -	- - - - - -	- - - - - -
0.17 DEG (N-S) 0.	0.17 DEG 0.09 DEG	- - - - - -	- - - - - -	- - - - - -
- - - - - - - -	0.65 DEG	- - - - - -	- - - - - -	- - - - - -
- - - - - - - -	0.1 DEG	- - - - - -	- - - - - -	- - - - - -
3 SEC ARC OVER 1 ORBIT DAY	0.001 DEG	- - - - - -	- - - - - -	- - - - - -
- - - - - - - -	0.2 DEG	- - - - - -	- - - - - -	- - - - - -

PROFILE EXECUTE CONTROL MECHANISM JETS

CONTROL MECHANISM PAGE 1

CONTROL MECHANISM	CONTROL MECHANISM JET GAS	CONTROL MECHANISM JET SIZE	CONTROL MECHANISM JET MANUFACTURER
GAS JET	HYDRAZINE	1 LBF	HUGHES AIRCRAFT CO.
GAS JET	HYDRAZINE	1 LBF	HUGHES AIRCRAFT CO.
- - - - -	- - - - -	- - - - -	- - - - - - -
GAS JET	HYDRAZINE	- - - - -	HUGHES AIRCRAFT CO.
GAS JET	NITROGEN	0.4 LB	- - - - - - -
GAS JET	- - - - -	5 LB	HUGHES AIRCRAFT CO.

PROFILE EXECUTE ATTITUDE CONTROL LOGIC

ATTITUDE CONTROL LOGIC PAGE 1

ATTITUDE CONTROL LOGIC,TECHNOLOGY	ATTITUDE CONTROL LOGIC,MANUFACTURER
CLOSED LOOP DESPIN ANALOG SERVO	HUGHES AIRCRAFT CO.
CLOSED LOOP DESPIN ANALOG SERVO	HUGHES AIRCRAFT CO.
DIGITAL CLOSED-LOOP FEEDBACK - NO PROGRAMABILITY	HUGHES AIRCRAFT CO.
ANALOG NULL DESPIN	HUGHES AIRCRAFT CO.
SUN CE	HUGHES AIRCRAFT CO.
- - - - - - - - - -	HUGHES AIRCRAFT CO.

PROFILE EXECUTE ATTITUDE KNOWLEDGE

ATTITUDE KNOWLEDGE PAGE 1

ATTITUDE KNOWLEDGE, REMARKS	ATTITUDE KNOWLEDGE, ALL	ATTITUDE KNOWLEDGE, PITCH	ATTITUDE KNOWLEDGE, ROLL	ATTITUDE KNOWLEDGE, YAW
0.004 DEG RESOLUTION	- - - - - - -	0.02 DEG	- - - - -	0.02 DEG
0.004 DEG RESOLUTION	- - - - - - -	0.02 DEG	- - - - -	0.02 DEG
ALLOWED TO DRIFT EACH ORBIT DAY - THEN RESTORED W/I 0.05 DEG	0.05 DEG	- - - - -	- - - - -	- - - - -
- - - - - -	0.1 DEG	- - - - -	- - - - -	- - - - -
1 SEC ARC OVER 1 ORBIT DAY	0.0003 DEG	- - - - -	- - - - -	- - - - -
ALLOWED TO DRIFT EACH DAY, RESTORED TO WITHIN 0.05 DEG OF SPECIFIED SPIN AXIS ATTITUDE	0.05 DEG	- - - - -	- - - - -	- - - - -

PROFILE EXECUTE ATTITUDE REFERENCE SENSOR

ATTITUDE REFERENCE SENSOR								PAGE 1
EARTH	SUN	STAR	MAGNET-OMETER	ELECTRO-MAGNET-OMETER	ACCELER-OMETER	BEACON	OTHER	
EARTH	SUN	- - - -	- - - -	- - - -	- - - - -	MONOPULSE BEACON	- - - -	
EARTH	SUN	- - - -	- - - -	- - - -	- - - - -	MONOPULSE BEACON	- - - -	
SPINNING EARTH	SUN	- - - -	- - - -	- - - -	- - - - -	- - - - - - - - -		
EARTH	SUN	- - - -	- - - -	- - - -	ACCELETOMETER (FOR ACTIVE NUTATION CONTROL IN TRANSFER ORBIT)	- - - - - - - - -		
- - - -	SUN	STAR	- - - -	- - - -	- - - - -	- - - - - - - - -		
EARTH	SUN	- - - -	- - - -	- - - -	- - - - -	- - - - - - - - -		

PROFILE EXECUTE ATTITUDE REFERENCE SENSOR MFGR

ATTITUDE REFERENCE SENSOR MANUFACTURER PAGE 1

EARTH	SUN	STAR	MAGNET-OMETER	ELECTRO-MAGNET-OMETER	ACCELER-OMETER	BEACON	OTHER
BARNES ENG.	HUGHES AIRCRA FT CO.	- - - -	- - - -	- - - -	- - - -	HUGHES AIRCRA FT CO.	- - - -
SERVO CORP.	HUGHES AIRCRA FT CO.	- - - -	- - - -	- - - -	- - - -	HUGHES AIRCRA FT CO.	- - - -
HUGHES AIRCRA FT CO.	HUGHES AIRCRA FT CO.	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
HUGHES AIRCRA FT CO.	HUGHES AIRCRA FT CO.	- - - -	- - - -	- - - -	SUNSTRAN D	- - - -	- - - -
- - - -	HUGHES AIRCRA FT CO.	HUGHES AIRCRA FT CO.	- - - -	- - - -	- - - -	- - - -	- - - -
HUGHES AIRCRA FT CO.	HUGHES AIRCRA FT CO.	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -

PROFILE EXECUTE PRIMARY POWER SOURCE

PRIMARY POWER SOURCE PAGE 1

CLASS	DESIGNATION	MANUFACTURER
SOLAR ARRAY	- - - - - - -	HUGHES AIRCRAFT CO.
SOLAR ARRAY	- - - - - - -	HUGHES AIRCRAFT CO.
SOLAR ARRAY	- - - - - - - - - - - - - - -	
SOLAR ARRAY	- - - - - - -	HUGHES AIRCRAFT CO.
SOLAR ARRAY	- - - - - - -	HUGHES AIRC
SOLAR ARRAY	- - - - - - -	HUGHES AIRCRAFT CO.

PROFILE EXECUTE PRIMARY POWER

PRIMARY POWER SOURCE PAGE 1

MAXIMUM OUTPUT DESIGN	BEGIN OF LIFE	END OF LIFE	MAXIMUM ARRAY POWER	BETA ANGLE EXCURSIONS	ARRAY ARTICULATION MOUNTING	ARRAY ARTICULATION ROTATION
- - - - -	320 W (EQUINOX)	250 W (SUMMER SOLSTICE)	- - - -	23 DEG	SPINNING CYLINDER	- - - - -
- - - - -	320 W (EQUINOX)	250 W (SUMMER SOLSTICE)	- - - -	23 DEG	SPINNING CYLINDER	- - - - -
- - - - -	390 W	305 W (AFTER 5 YRS)	- - - -	23 DEG	SPINNING CYLINDER	- - - - -
- - - - -	- - - - - - -	212 W (SUMMER SOLSTICE)	- - - -	23 DEG	SPUN	- - - - -
- - - - -	464 W	402 W	- - - -	0 DEG	DESPIN	- - - - -
- - - - -	708 W	600 W	23 DEG	- - - -	SPINNING CYLINDER	- - - - -

PROFILE EXECUTE SECONDARY POWER

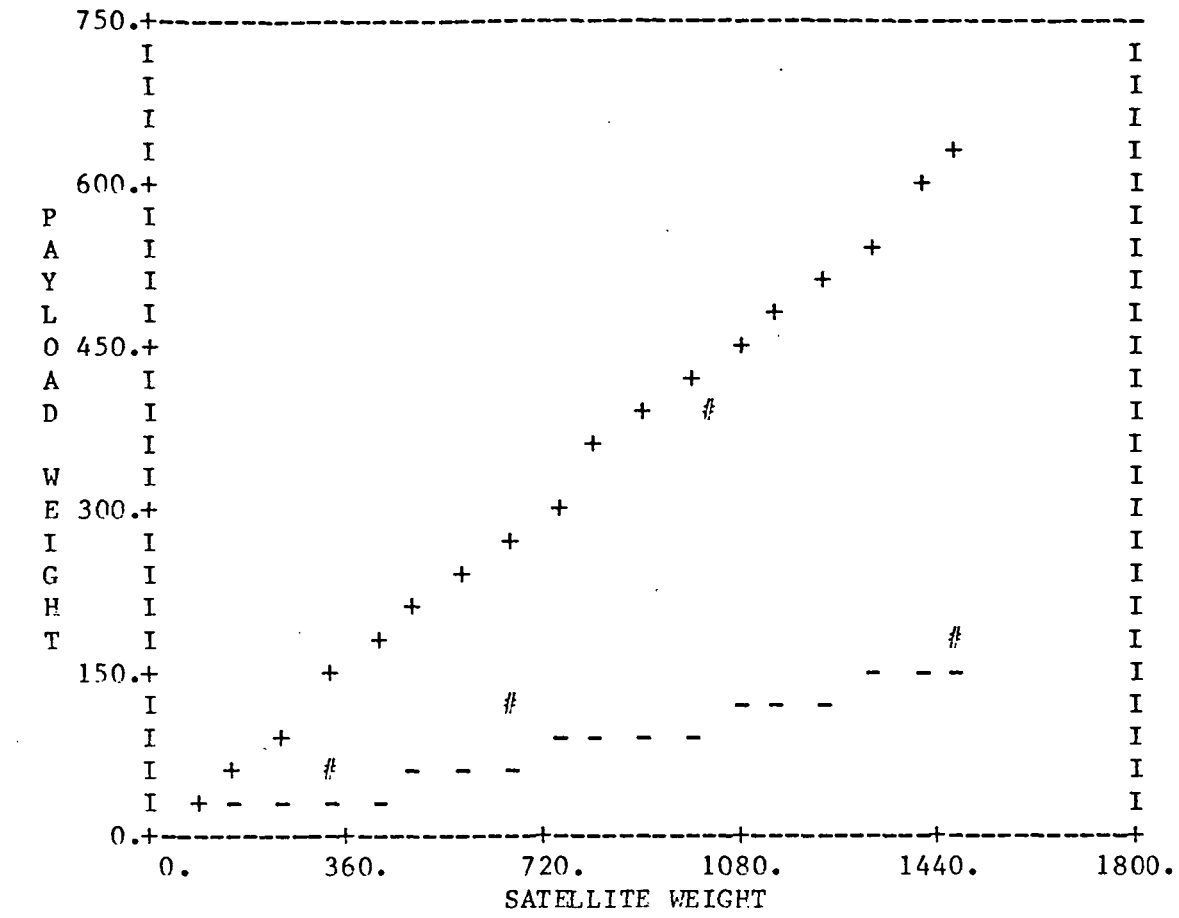
SECONDARY POWER SOURCE PAGE 1

CLASS	NUMBER	MAXIMUM POWER	CAPACITY	TYPE	MANUFACTURER
BATTERIES	- - -	- - - -	16 AMP-HR	NICD BATTERY CELLS	GENERAL ELECTRIC
BATTERIES	- - -	- - - -	16 AMP-HR	NICD BATTERY CELLS	GENERAL ELECTRIC
BATTERIES	2	- - - -	10 AMP-HR	NICD BATTERY CELLS	- - - - - - -
BATTERIES	2	- - - -	3 AMP-HRS	NICD BATTERY CELLS	HUGHES EAGLE-PITC
BATTERIES	2	- - - -	12 AMP-HRS	NICD BATTERY CELLS	GENERAL ELECTRIC
- - - - - -	- - -	0 FOR ECLIP SE OPERA TION	- - - - - -	NICD BATTERY CELLS	GENERAL ELECTRIC

APPENDIX I

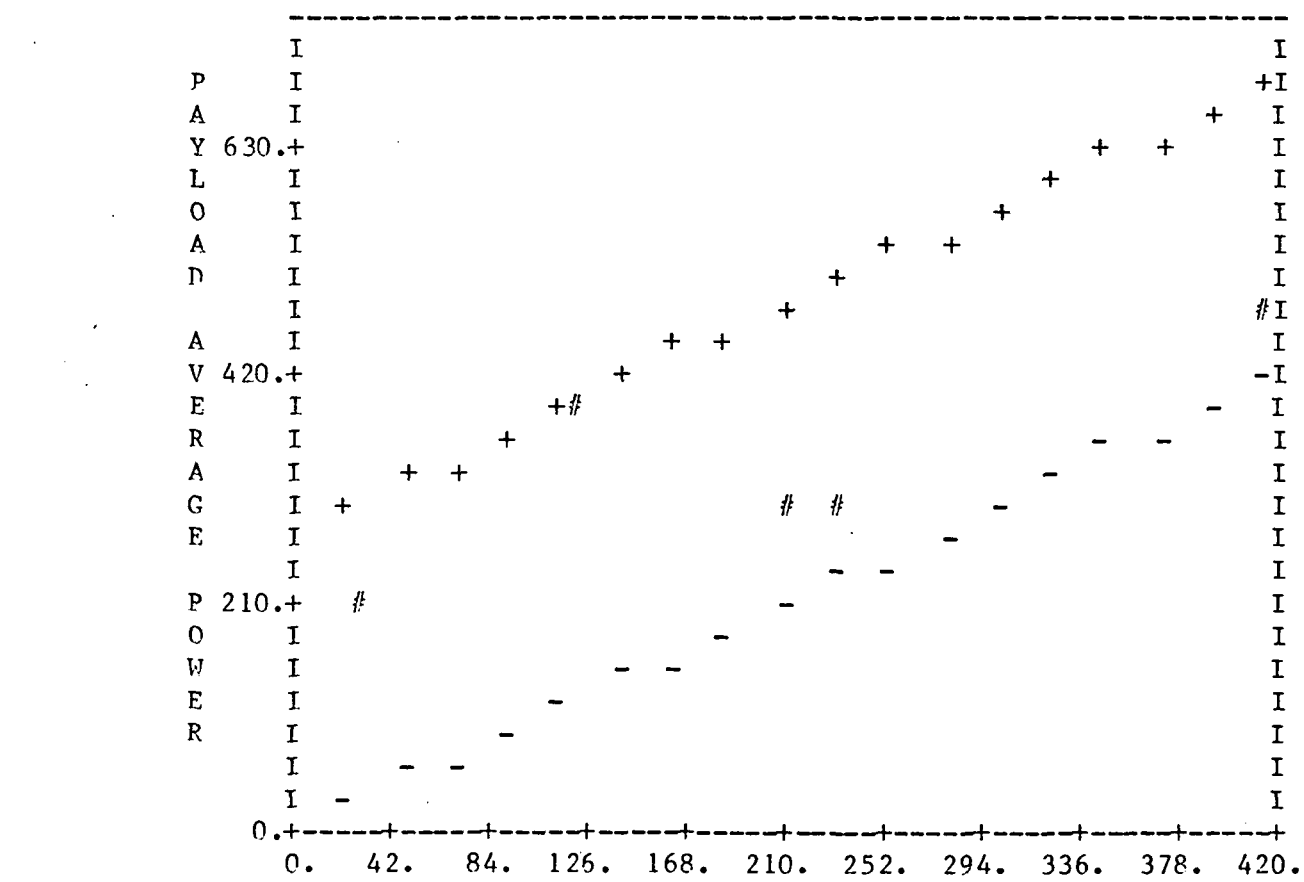
EXAMPLES OF PROFILES FOR DATA PLOTS OF SATELLITE DESIGN PARAMETERS

```
ENTER YOUR REQUEST
  2/ PROFILE EXECUTE DATA PLOTS


THE FOLLOWING ARE PARAMETERS TO BE SATISFIED
                X VAR ? WSAL
           NUM POINTS ? 18
              SLOPE 1 ? ".42"
              SLOPE 2 ? ".105"
                Y VAR ? WSP
              X TITLE ? SATELLITE WEIGHT
              Y TITLE ? PAYLOAD WEIGHT

ENTER YOUR REQUEST
  2/ DEFINE

WHAT FIELDS DO YOU WANT TO SEE?
ENTER FIELD NUMBERS SEPARATED BY COMMAS OR ALL
   / XM=MAX(WSAL)

DO YOU WANT TO ENTER ANOTHER EXPRESSION?
   / XN=SUM("1.")

HOW MANY ITEMS DO YOU WANT FIRST?
   / 18

DO YOU WANT TO ENTER ANOTHER EXPRESSION?
   / X=CUM("1.")*XM/XN,Y1=".42"*X,Y2=".105"*X

DO YOU WANT TO ENTER ANOTHER EXPRESSION?
   / X3=WSAL,Y3=WSP

DO YOU WANT TO ENTER ANOTHER EXPRESSION?
   / NO

FINISHED WITH PRINT OUT
ENTER YOUR REQUEST
  2/ SAR(LPLOT)

THE FOLLOWING REQUIRED PARAMETERS(S) NEED TO BE ENTERED
Y         X
   / FRAME=3,CHAR(+,-,#),X1=X,Y1=Y1,X2=X,Y2=Y2,X3=X3,Y3=Y3,XLABEL(SATE
   / LLITE WEIGHT),YLABEL(PAYLOAD WEIGHT)
```




```
ENTER LPLOT COMMAND

   / STOP
ENTER YOUR REQUEST
  2/

    ABORT
ENTER YOUR REQUEST
  2/ PROFILE EXECUTE DATA PLOTS


THE FOLLOWING ARE PARAMETERS TO BE SATISFIED
              X VAR ? PAP
         NUM POINTS ? 18
            SLOPE 1 ? "275."+"1."
            SLOPE 2 ? "1."
              Y VAR ? PAS
            X TITLE ? SATELLITE AVERAGE POWER
            Y TITLE ? PAYLOAD AVERAGE POWER

ENTER YOUR REQUEST
  2/ DEFINE

WHAT FIELDS DO YOU WANT TO SEE?
   / XM=MAX(PAP)
```

```
DO YOU WANT TO ENTER ANOTHER EXPRESSION?
   / XN=SUM("1.")

DO YOU WANT TO ENTER ANOTHER EXPRESSION?
   / X=CUM("1.")*XM/XN,Y1="275."+"1."*X,Y2="1."*X

DO YOU WANT TO ENTER ANOTHER EXPRESSION?
   / Y3=PAP,Y3=PAS

DO YOU WANT TO ENTER ANOTHER EXPRESSION?
   / NO

FINISHED WITH PRINT OUT
ENTER YOUR REQUEST
  2/ SAR(LPLOT)

THE FOLLOWING REQUIRED PARAMETERS(S) NEED TO BE ENTERED
Y         X
   / FRAME=3,CHAR(+,-,#),X1=X,Y1=Y1,X2=X,Y2=Y2,X3=X3,Y3=Y3,XLABEL(SATE
   / LLITE AVERAGE POWER),YLABEL(PAYLOAD AVERAGE POWER)
```




```
ENTER LPLOT COMMAND

   / STOP
ENTER YOUR REQUEST
  2/
```